Patient safety culture – opportunities for healthcare management

The Safety Attitudes Questionnaire - Short Form 2006, Norwegian version – 1) Psychometric properties, 2) Variation by organisational level and 3) by position

Ellen Catharina Tveter Deilkås

Acknowledgements

This work is the result of a long process which has indebted me to many people.

First of all, I want to thank my supervisor, Dag Hofoss, for patiently teaching me the methods which have been used in this thesis. You have always made me feel welcome to discuss new perspectives and ideas and your pedagogic talent, widespread knowledge and good humour have been encouraging.

I want to thank and commemorate Else Wiik Larsen who hired me as a junior physician in 1997, and encouraged me to specialize in internal medicine in her department. I depended on her support as a local and eventually national representative for junior physicians in the Norwegian Medical Association. She always encouraged me to analyze organizational problems in a system perspective.

I am grateful for the opportunities I have been given by the Norwegian Medical Association, especially through leading the Patient Safety Committee, which led me into this research. I am grateful to the President of the Norwegian Medical association, Torunn Janbu, who gave me her recommendation when I applied to the position as a research fellow.

I am incredibly thankful to Pål Gulbrandsen for hiring me to do this research. The open and relaxed atmosphere at Høkh has been supportive and comforting.

I thank Reidun Skårerhøgda for generous help in making tables and figures.

I thank my parents, Bente and Øystein Tveter, for providing an environment of discussion and reflection and for encouraging an understanding of the consequences of social conditions. Thanks to my siblings, Anne Tveter, Frank Tveter, Stein Tveter and Benedicte Tveter Kivle,

for wonderful memories, inspiration, moral support and sound advice. A special thanks to Benedicte, who gave crucial input to this thesis towards the end of its completion.

I could not have done this work without your practical support, trustworthy friendship and love, Jan-Tore. Thanks for being such a dependable father to our son.

I am so grateful to be your mother, Erlend. You are the happiness of my life.

Table of Contents

Preface

My interest in patient safety is probably influenced by the fact that my family moved to Tanzania in 1969, where my father was a regional representative and administrator for the Lutheran World Federations refugee field service. When I was four, I frequently went with him on field trips to visit refugee camps, and experienced well organized, safe sites where I could play with rabbits bred for cooking, and where Danish friends led agricultural projects that helped the refugees to subsist. We left Tanzania in 1974 and later moved to Botswana in 1978 where my father was the Norwegian consul and administrator of the Norwegian development aid programme (NORAD) for four years. As a neighbouring country to the apartheid regime of South Africa we had close contact with refugees through the liberation movement (ANC) and a cultural organization (MEDU art ensemble). A close friend, the artist Thami Mnyele, was killed after we left in a raid by South African commando soldiers.

I decided to study medicine to learn how social conditions influence people's health, presuming that practicing as a physician would give a better understanding than purely theoretical studies. As a medical student I was elected as a representative for the Norwegian Medical Association. My aim was to make physician life more family friendly, because I believed that a good work-life balance would make physicians more empathetic and considerate toward their patients. Leading the Student Branch of the Norwegian Medical Association (NMA), and later as a local hospital representative and board member of the Junior Doctors Organization (also a branch of the NMA) I worked to improve physicians' work-life conditions, and found it to be related to how healthcare is organized. As an internist I learned how malfunctioning hospital organizations undermined caretakers' efforts to take well care of their patients. The lack of opportunity for junior doctors to communicate with responsible leaders on how care was organized was striking. Regular staff meetings where junior doctors could meet unit or department management, to discuss routines and administrative procedures, did not (and still do

not) exist, although junior doctors have a crucial role in patient care. After a while I understood that this was different for consultants and for nursing staff. They had their own staff meetings where junior doctors were not invited. I reflected that this practice did not acknowledge the importance of the information that junior doctors have on how malfunctioning routines and administrative procedures inhibit patient care.

Having been involved in a regional initiative conducting medical chart review on stroke patients, I was appointed a member of the new Patient Safety Committee of the NMA in 2005. The Patient Safety Committee (PSC) was a follow up after the quality improvement committee had been laid down, and new ones had been established within each speciality branch. The NMA wanted to promote the delivery of safe healthcare across specialities. The Patient Safety Committee was given the mandate to advise the NMA board on issues concerning patient safety. In December 2006 I was appointed as chairperson of the committee. I was then asked to make a patient safety strategy, which the NMA board adopted in 2007. It later asked us to make an action plan, which they adopted in 2008.

The PSC represents the NMA in national initiatives made by the National Unit for Patient Safety, which was established in the spring of 2007 at the National Knowledge Centre for Healthcare. In planning its strategy the National Unit for Patient Safety gathered a coalition of healthcare authorities, labour organizations (including the PSC), and patient organizations to several roundtable conferences, where strategies for patient safety improvement work in Norway was discussed. The Norwegian System of Compensation to Patients (NPE) took the initiative to organize a National Patient Safety conference in 2007, before the National Unit for Patient Safety was established. As soon as it was operative the National Unit for Patient Safety proceeded to organize the first Norwegian Patient Safety conference in 2008. The conference was planned in cooperation with healthcare authorities, the NPE, labour organizations (including the NMA), and patient organizations. Another conference was held in 2009. The

National Unit for Patient safety has also initiated several working groups, which I have participated in on behalf of the PSC. The two working groups I participated in were concerned with a national campaign for patient safety and patient safety indicators. In 2009 the Norwegian Alliance for Patient Safety was established, linking organizations representing health care workers and patients. Its purpose is to increase the priority of patient safety. The National unit for patient safety has a secretary function for the Alliance. I represent the NMA in the Alliance.

As a member of the PSC I attended my first patient safety conference in February 2006. It was held in Birmingham by the National Patient Safety Agency (NPSA). The massive commitment at the conference for making healthcare safer was a contrast to the lack of organizational support I until then had experienced as a clinical doctor in Norway. At the conference I participated at a workshop on patient safety culture where Professor Bryan Sexton of the Johns Hopkins Quality and Safety Research Group presented survey results using the Safety Attitudes Questionnaire (SAQ). When he showed how staff perceptions of safety culture correlated with outcomes, including incidence of venous thromboembolism and postoperative infections, I thought this questionnaire would be interesting to translate and validate in Norwegian. He concluded that safety culture surveys such as the SAQ facilitate direct communication between frontline workers and upper management on how patient safety culture is perceived. This resonated well with my experience of lacking possibilities for junior doctors to communicate with management on how routines and organizational conditions inhibit safe patient care.

Back at home, surfing on the internet on a Saturday evening, I found that the Centre for Health Services Research at my neighbouring hospital was announcing a grant to validate the SAQ. The deadline had expired but I applied online immediately. The day after, I received a phone call from the director, Pål Gulbrandsen, and was invited to an interview.

As a researcher in patient safety culture I am together with my supervisor part of a national network for patient safety research. We also participate in a Nordic network for safety culture research in healthcare, of which I coordinate a subgroup studying the relationship between safety culture for patients and employee safety. We are also part of an expert group under the Nordic Council of Ministers with a mandate to give advice on how patient safety culture assessment can be used as an indicator for patient safety. As members of the Nordic expert group we have also been invited to be part of an expert group in EUNetPas, which is a project funded and supported by the European Commission. One of the aims of EUNetPas is to promote a culture of patient safety. In this expert group we have presented information on our experience with the SAQ.

When starting patient safety research I believed that staying in clinical practice would help me to keep a clinical perspective as a researcher. I therefore still practice one day a week as a consultant in a multidisciplinary outpatient clinic for rehabilitation of patients that have had a brain stroke. Although this study relies heavily on statistical evidence, I have chosen to present some examples I have experienced as a healthcare worker. My interest in patient safety has been influenced by such experiences. The examples also illustrate the relevance of my findings and give room for understanding and interpreting the statistical evidence.

Abstract

Introduction

Patient safety culture is how management and staff interact in order to protect patients from adverse events in healthcare. It includes routines, practices, awareness, attitudes and priorities which in a good patient safety culture make the likelihood for adverse events as small as possible. This thesis addresses how patient safety culture in a Norwegian hospital can be measured by mapping staff perceptions with the Safety Attitudes Questionnaire (SAQ). Among the first reports to create international interest in patient safety was the 1991 Harvard Medical Practice Study. 30,121 randomly selected records were reviewed from 51 randomly selected acute care, non-psychiatric hospitals in New York State in 1984 (1). The results showed a substantial amount of injury to patients from medical mismanagement or iatrogenic harm. Patient safety was brought to the forefront of public debate worldwide, by the 1999 Institute of Medicine publication, "To Err is Human," which estimated that each year more Americans die from medical errors than from traffic accidents or cancer mammae (2). This landmark report called for a more system-oriented approach in dealing with errors in healthcare and has resulted in increased research on how circumstances in which errors occur can be prevented. Another landmark report prepared for the British government, "An organization with a memory," emphasized how the mindset, values and priorities of employees and management influence patient safety. It acknowledged that experiences of adverse events must be valued as sources of information necessary for health care organizations to learn and improve, but that such learning processes are obstructed by cultures in the healthcare organizations that prevent staff from being open about adverse events (3). In two recent reports the World Health Organization (WHO) has called for rigorous studies on how the cultures of health care organizations influence patient safety (4;5).

Research aims

In this thesis we have examined the psychometric properties of the Norwegian translation of the Safety Attitudes Questionnaire (SAQ), at what hospital level safety culture problems are most prevalent and if safety climate assessments of frontline staff are different from those of their superiors. Implications for the improvement of patient safety culture are discussed.

Methods

We collected data from 47 care giving units in one Norwegian university hospital from October to December 2006. 1,306 care givers, including physicians and nurses, completed and returned questionnaires at a response rate of 68%. A confirmatory factor analysis was done to assess whether the Norwegian data adequately fitted a factor structure published for benchmarking purposes on data from the US, the UK and New Zealand. A multilevel analysis was done to find how the Norwegian questionnaire mapped variance of safety culture by the hospital's hierarchical structure. Finally, an independent sample T-test was done to assess whether safety culture perceptions amongst frontline staff differed from those of their superiors.

Results

The Norwegian data fit adequately the published factor structure of the benchmarking data from the US, the UK and New Zealand. A significant amount of variance in the data was found at the organizational level, and especially at the lowest level--the ward level. Frontline staff perceived patient safety culture to be significantly worse than their superiors.

Discussion

The idea of creating a communication channel from staff to executive leadership with patient safety culture surveys inspired this research, as did an expert group under the World Health

Organization, which rated patient safety culture as the third most important research topic on patient safety in developing countries.

We chose to translate and validate the Safety Attitudes Questionnaire (SAQ) because, in spite of limited external validation, we found it to be the best validated extant questionnaire on patient safety culture. The results in the papers show that the factor structure of our translated version adequately fits the published factor structure of the SAQ, although it is not perfect. They also support existing research evidence, which suggests that patient safety culture exists as a phenomenon at several organizational levels, of which most of the variation is found at the ward level. The ward level should therefore not be ignored in the pursuit of mapping and improving patient safety culture. This implies that an adequate number of staff have to be included in the sample in order to analyze the variation at the ward level. The literature suggests including all staff working in the wards.

We found that charge nurses perceived the patient safety climate to be better than their subordinate staff. Although this may be because they might have a better overview over how the ward functions and how adverse events can be prevented, the fact that they are less involved in direct clinical care may give a distance to the patients' and subordinates' experiences of adverse events, their consequences and how they are handled. Executive leaders can therefore not rely on reports on patient safety culture from subordinate leaders alone. In order to have unfiltered information they need to conduct safety culture surveys on frontline staff.

Conclusion

The Norwegian translation of the Safety Attitudes Questionnaire maps the patient safety culture of hospital wards and departments in a valid and reliable way. A significant part of the patient safety culture variation is found at the ward level. Measurements of patient safety culture should therefore include enough staff to be able to break the results down to ward level.

Perceptions of safety climate depend on the perceiver's position in the hospital hierarchy. This may cause information on patient safety to be increasingly filtered as it ascends to the top levels in the organization. Patient safety culture assessments supplement reports that senior managers receive from subordinate leaders.

1. Introduction and hypotheses

Although the risk of harming patients is evident to most caregivers, eliminating or reducing risk has not always been the first priority of health care management. Patient safety has been regarded primarily as the responsibility of care givers, and therefore as something that management could take for granted. This perspective has left caregivers with the blame for adverse events without management reflecting critically on how surrounding conditions may prevent errors or contribute to them happening. Knowledge of the frequency of adverse events in healthcare has in the last decade spurred interest for understanding their causes. This has led to studies of staff perceptions regarding the extent they manage to keep patients safe. Results show significant variation between care-giving units, predicting variability in safety behaviour amongst staff and in patient safety results. The concepts of safety culture and safety climate are used to describe this phenomenon.

Safety culture appeared for the first time as a concept in the scientific literature in 1951 (6). After the Chernobyl accident in 1986 it became widely known. The investigation after the accident discovered a lack of priority of safety matters at multiple levels in the organization, which contributed to the incident. The concept of safety culture was further developed by organizational psychologists doing research in the manufacturing industry, and in high reliability organizations like nuclear power plants and the aviation industry (7;8). Safety culture is described as a construct with dimensions including Teamwork Climate, Safety Climate, Management Support for patient safety, Stress Recognition, and Working Conditions (9). Safety culture research in healthcare has focused primarily on operating theatres and intensive care units (10), but there are also studies from ordinary wards (11;12) and from primary care (13;14).

Studies of the relationship between safety climate measurements and organizational outcomes in healthcare, show that the concept can be used to predict outcome. This has led to increased

interest in how such measurements can help organizations improve their safety performance (11;12;15;16). Efforts to measure safety climate and other dimensions relevant to organizational performance and clinical quality have led to the development of a number of instruments. It is important to ensure that their measures are reliable, valid and accurate (7). This thesis presents an overview of how patient safety has been studied worldwide, suggesting that patient culture surveys is a sound approach for patient safety improvement. To facilitate further research and application of tools for addressing patient safety culture, we have checked the psychometric properties of the Norwegian translation of the Safety Attitudes Questionnaire (SAQ) and studied how the questionnaire's results vary according to the hospitals hierarchic structure and according to responders position in the hierarchy (17).

Our first hypothesis is: The published factor structure for Safety Attitudes Questionnaire benchmarking data from the US, the UK and New Zealand also fits the Norwegian data adequately.

We tested the first hypothesis by doing a confirmatory factor analysis. The test is further described in chapter 6.1. and in the second article.

Our second hypothesis is: Patient safety culture scores mapped by the Norwegian questionnaire vary by ward and department, but more across wards than across departments.

This hypothesis was tested with a multi level analysis; in order to find out at what hospital level safety culture problems are most prevalent, for understanding better where to direct improvement efforts. The test is further described in chapter 6.4. and in the third article.

Our third and last hypothesis is: Perceptions of safety climate amongst employees follow a hierarchical pattern and are more positive the further away from the patients the employees work.

We tested this hypothesis with independent samples T-test. If our results supported the hypothesis it would indicate that top management receive filtered information on safety climate from their subordinate leaders. This would mean that safety climate assessments of frontline staff perceptions provide a supplementary unfiltered source of information about the safety climate in the care-giving units, and thus are worth doing. Further description of the testing of this hypothesis is described in chapter 6.5. and in the fourth article.

2. Patient safety – as public concern and science

Public concern for patient safety has grown. We will now take a closer look at how it has developed to become a global issue over the past decade, and see how the nature of adverse events and measures to reduce organizational risk has been addressed by scientific literature. We will see how patient safety culture is a newcomer on the patient safety research agenda and how it complements the other approaches.

For almost two decades major warnings have been raised against unsafe conditions of healthcare delivery. Surveys of adverse events in hospital care have shown that the probability for a patient to be harmed during an admission in a hospital in a Western country is 10% (18). Following the warnings, many nations have adapted policies with the intent to improve the way healthcare is managed and organized in order to reduce adverse events. This has demanded a mentality change for understanding that patient results in healthcare depend not only on the performance of individual clinicians but also on how clinical work is organized and coordinated and how routines for communication and cooperation function. The concept of patient safety refers to organizing healthcare so that the risk of patient harm is reduced. It means making sure that mistakes made by individual healthcare workers do not lead to patient harm. The following case shows how a patient at risk experienced harm after being admitted to the hospital. A 64 year old woman with severe pneumonia was admitted to the medical ICU where I did my specialist training. Because of an implanted mechanical aortic valve she depended on careful anticoagulation therapy to prevent blood clots from forming in her heart and dispersing to the rest of her body. Adequate anticoagulation in her case was based on tight monitoring of the blood test, INR, to ensure a value between 2.5 and 3.5.

The pneumonia treatment proceeded well and she was admitted to a regular ward. After some days I received a call from the physician at the ward who said she had collapsed and was unconscious. Before this she had been doing fine, was on her feet and was due to leave the

hospital the day after. The physician was puzzled and did not understand her condition and wanted to refer her to the ICU. She came to the ICU in a coma with a condition beyond recovery. The INR value explained the situation. Her family said she had been well aware of the risks associated with her mechanic aortic valve and the anticoagulation therapy it demanded. She had therefore managed her anticoagulation treatment very carefully. In our hospital she automatically lost control over her own anticoagulation treatment and we were unfortunately not capable to manage it for her.

Everyone in healthcare has experienced circumstances under which mishaps are more or less likely to occur. The idea of safety design by changing and molding circumstances of care delivery follows naturally. Poorly designed systems for delivering health care hide latent failures that may lie dormant for a long time until some unfortunate health care provider happens to release them. In the case mentioned above the woman had been placed in the corridor in an overcrowded ward. Although the case was never analyzed for contributing causes, lacking competence concerning the risk related to her heart condition, and lack of time to communicate with each patient, in which she might have questioned the blood sample results herself probably played a part. Another example is when an anesthesiologist moves to observe the patient better, and by accident switches off the life-supporting machine because his clothes happen to pull the uncollared dipswitch into off-mode, or when long chains of patient handovers create communication breakdown, paving the way for adverse events (19).

The increased awareness of risks related to delivering healthcare has resulted in a call for the establishment of routines for reporting, analyzing and learning from adverse events, and developing measurements for monitoring results of interventions to reduce patient harm has been emphasized. To give this work priority, the necessity of support and active participation by local and executive leadership has been highlighted (20;21).

2.1 The development of public concern for Patient safety

In order to understand how public concern for patient safety has grown to become a global issue we need to study how it started and from where it spread. We begin with the country where it was ignited, the Unites States of America.

2.1.1. The movement of healthcare improvement in the United States of America

The following paragraphs describe how the movement for patient safety improvement in the USA started from the meeting of two people and expanded to a national organization that has developed theory and strategies for campaigns involving thousands of hospitals.

In the mid eighties doctors Don Berwick and Paul Batalden met by coincidence at a conference in Boston and instantly found that they both shared a conviction that they could do more for their patients by improving the way healthcare was delivered than by practicing on individuals only (22). Their meeting in Boston was the beginning of a continuing companionship in this pursuit. Today they are both board members of The Institute of Healthcare Improvement, of which Don Berwick is also President and CEO. Paul Batalden is the Director of the Centre for Leadership and Improvement at The Dartmouth Institute for Health Policy and Clinical Practice.

They inspired each other to explore Deming's theory on promoting improvement of quality. The theory implies constant monitoring processes of healthcare, like how many patients, for example, receive recommended treatment for myocardial infarction. This is done by using statistical process control charts. The method shows how reliable health care processes are and provide a baseline for improvement efforts. It represents a new and different approach from only inspecting the outcomes of bad quality health care. They were convinced that promoting quality in healthcare through facilitating better healthcare processes could make an important impact in healthcare. They arranged courses to spread the theories and methods of improvement, but felt more had to be done to give impact to the movement for quality

improvement in healthcare. For this purpose they founded a non-profit organization. Together with a small group of highly competent and select people, they created The Institute of Healthcare Improvement (IHI) in 1991. This independent organization aims to transform and improve the quality of healthcare in the United States. The first year IHI invited clinicians, quality experts and others who had taken their courses in quality improvement over the years to the first National Forum on Quality Improvement in Healthcare. The conference gathered 1600 delegates in Orlando, Florida for 3 days. Since then the conference has been held annually. Today it involves more than 6000 participants. These conferences have become a driving force in healthcare improvement in the US and internationally. About 10% of the participants come from other countries.

To drive implementation of theory into practice the IHI started the Breakthrough Series program addressing specific clinical issues, including reducing caesarean section rates, and improving management -at-home of congestive heart failure. Their aim was to let experts of clinical topics meet experts of clinical practice in order to test and evaluate organizational solutions at the front line of patient care. This program extended to Norway, through the Deputy Secretary General Hans Asbjørn Holm of the Norwegian Medical Association. The first Norwegian project in the Breakthrough Series Program was launched in 1998. It has since been implemented across nine different clinical domains, including caesarean section rates, treatment of back pain in primary care, use of constraint in psychiatric care, and care in nursing homes. The projects have involved a number of institutions on every topic (23).

In 1991 the Harvard Medical Practice Study (HMPS) published the incidence of adverse events based on a review of 30,000 randomly selected medical charts from 51 hospitals in New York state. The study directed attention to how human error is an inevitable cause of adverse events and lack of quality in healthcare. Through this study and other research, Lucian Leape, a pediatric and thoracic surgeon, created awareness over how processes of health care are

vulnerable, proposing that success depends less on individual human actions, and more on well organized procedures, systems and routines. Although the study did not stimulate change when it was published, the data provided the basis for the report “To Err Is Human,” published by the Institute of Medicine (IOM) in 1999. This report extrapolated the HMPS results to the entire American population, with results indicating that flaws in healthcare delivery was one of the country’s leading causes of death, costing about 98,000 lives each year. This report made instant headlines, worldwide, and Don Berwick and Lucian Leape became the leading spokesmen for breaking down the “culture of silence” about human error and adverse events in healthcare.

In December 2004 the IHI launched an ambitious campaign with the goal of saving one hundred thousand lives over a period of 18 months by recruiting as many hospitals as possible to give greater priority to making health care safe and effective. The strategy was to implement the following six interventions: 1) deploy rapid response teams at the first sign of patient decline, 2) deliver reliable, evidence-based care for acute myocardial infarction to prevent deaths from heart attack, 3) prevent adverse drug events by implementing medication reconciliation, 4) prevent central line infections by implementing a series of interdependent, scientifically grounded steps called the "Central Line Bundle," 5) prevent surgical site infections by reliably delivering the correct perioperative antibiotics at the proper time, and 6) prevent ventilator-associated pneumonia by implementing a series of interdependent, scientifically grounded steps including the "Ventilator Bundle."

Although most of the interventions had already been adapted in the policy of major healthcare organizations, the systematic implementation was now encouraged by mobilizing a broad coalition of partners that created, advised and endorsed the campaign. The impact of the campaign was measured by comparing monthly mortality rates during the campaign with the mortality in the same months in the previous year. The raw death rate difference was

approximately 33,000. Case mix adjustment done by the methods of three different organizations yielded a total number of deaths of 89,000.

Critics have said that the campaign was not supported by adequate evidence to defend the resources demanded to implement the interventions (24). Randomized controlled surveys to prove the effect of the interventions have been called for. In addition, case-mix adjustment is pointed out as an inexact science that would not withstand rigorous scientific review; there also are problems of adjusted administrative codings, where hospitals have sought additional reimbursements by enhancing their observed-to-expected mortality ratios (24). They claim that the IHI has given an impression that the campaign was more scientifically sound than it actually was.

In answering the critics, the IHI states that they have been clear about the scientific uncertainty around the estimations of lives saved, but that these claims have not been published by the media. They also say that their measurement had no intent of isolating death rate reduction resulting from the campaign from that of other initiatives (25).

The 100K campaign and the IHI changed patient safety culture at a national level in the USA by increasing public awareness on the risks associated with modern healthcare and reducing public tolerance of unsafe healthcare. This made room for a change in national policy where safe healthcare delivery has become a priority.

2.1.2. From Bristol to the Commonwealth

We will now look at how public awareness of patient safety has developed in the United Kingdom (UK) and the Commonwealth countries. We will see how the Bristol Scandal has had a great impact on public demand for a new approach to patient safety in the UK, which spread to Australia, New Zealand, and Canada. In some of these countries national surveys on the incidence of adverse events have caused public demand for intervention.

General awareness of patient safety issues in Britain began in 1995 with reports on less than good pediatric cardiac surgery at the Royal Bristol Infirmary. The case that gained public attention involved a child who was scheduled for surgery against the advice of anesthesiologists, some surgeons, and the Department of Health. His death led to extensive local and national media attention as well as an external inquiry. The inquiry report concluded that the service at the Royal Bristol Infirmary was less than adequate and had a much higher (most of the time, double) mortality rate for children undergoing open heart surgery than other hospitals (26). The Bristol case had a historical impact on the confidence that British patients have in their National Health Service (27).The inquiry report presented 200 system-oriented suggestions for preventing similar cases from happening in the future. Public demand led to political action through a report called "An organisation with a memory." In this report an expert group led by the Chief Medical Officer recommended the National Health Service (NHS) develop a just and fair organizational culture with a pronounced will to learn from adverse events and to change routines when indicated. This led the NHS to form the National Patient Safety Agency (NPSA), which now coordinates NHS patient safety activities.

A symposium on patient safety and monitoring in Adelaide in 1987 sparked a new approach to patient safety in Australia (28). The symposium found that problems occurring in anesthetic practices in Australia should be identified and analyzed so that cost-effective preventive methods could be developed to minimize their adverse effects. It led to an incident monitoring study in anesthesia that began in 1988. The Australian Commonwealth Government provided funding to do incident monitoring on an institutional basis and a pilot study was conducted in six tertiary facilities in different Australian states. The release of the results from the Quality in Australian Health Care Study in 1995 prompted a strong public reaction. As a consequence, the Australian Patient Safety Foundation (APSF) was engaged to implement a patient incident reporting and monitoring system for public healthcare in

Southern Australia, The Australian Incident Reporting System (AIMS). In 2000 AIMS was also introduced to New Zealand.

In September 2001, The Royal College of Physicians and Surgeons of Canada recognized at its annual conference the need for a coordinated strategy to improve patient safety for Canadians. A national steering committee was established, supported by working groups responsible for addressing different aspects of patient safety. In 2002 it proposed an integrated national strategy for improving patient safety in Canadian healthcare, which included the establishment of a Canadian Patient Safety Institute (CPSI), intended to promote innovative solutions and to facilitate collaboration among governments and stakeholders to enhance patient safety (29). In 2003 the federal budget announced the provision of 10 million dollars annually to support patient safety initiatives, including creating the Canadian Patient Safety Institute. The CPSI spreads information on how to improve patient safety through conferences and its own website and leads initiatives to improve patient safety through campaigns. It also stimulates research on patient safety through annual research competitions.

In Scotland the Chief Medical Officer announced in March 2007 that hospitals across Scotland were to take part in a national programme aimed at improving patient safety. The Scottish Patient Safety Alliance was established to oversee the Scottish Patient Safety Programme (30). The programme aims to implement intervention strategies well known from the IHI campaigns within a timeframe of five years.

Awareness of the necessity of addressing patient safety spread and reached other countries in Europe, including the Netherlands, Belgium, and the Nordic countries.

2.1.3. Patient safety in the Nordic countries

We will now describe some of the patient safety initiatives made by national authorities in the Nordic countries of Denmark, Sweden, and Norway.

In Denmark the Danish Society for Patient Safety was established in 2002. It was initiated by the Danish Medical Association and rapidly became a broad coalition of hospital owners, labour unions and patient organizations (31). It immediately became the driving force in patient safety improvement work in Denmark by having a large impact on shaping Danish Law on Patient Safety, especially regarding the protection of whistle blowers who report adverse events. In 2007 it launched the campaign, ”Operation Life,” which was based on overlapping interventions with the 100K campaign. The campaign has contributed to an increased awareness of the problems with patient safety in Denmark and coached a large number of healthcare workers to lead and evaluate improvement efforts in healthcare (32). The campaign in Denmark has been an inspiration to healthcare improvements in the other Nordic countries.

In Sweden, Jonkøping county has since 1998 engaged in quality improvement in healthcare under Göran Hendrik’s leadership of the Qulturum, the county’s centre for quality, leadership and management. The centre has spread improvement knowledge to an international audience by organizing annual Microsystems festivals. From here, improvement knowledge has branched and spread now, actively supported by the national Swedish health authorities.

The Norwegian Medical Association has initiated healthcare improvement projects through the Breakthrough Series Program since 1998. The effort has been welcomed, but not actively funded, by government. The National Unit for Patient Safety was established in 2007 with 5 employees. In 2008 the first national conference on patient safety was organized in Oslo. It was fully booked and had 400 participants, and has just been repeated in 2009. In 2009 the Norwegian government launched a reform, ”Samhandlingsreformen,” with the purpose of improving coordination of patient services between hospitals and primary health care givers. Based on the experiences from Denmark and the USA, the Norwegian Department of Health has decided to launch a patient safety campaign for Norwegian healthcare in 2010.

2.1.4 Global initiatives for Patient safety

The next paragraphs describe the steps the World Health Organization has taken to improve patient safety worldwide.

In 2002 the 55th World Health Assembly passed a resolution urging member states to "pay the closest possible attention to the problem of patient safety; to establish and strengthen science-based systems necessary for improving patients' safety and the quality of health care, including the monitoring of drugs, medical equipment and technology." The resolution also requested the WHO Director-General in the context of a quality programme" to support the efforts of Member States to promote a culture of safety within health care organizations and to develop mechanisms; for example, through accreditation or other means, in accordance with national conditions and requirements, to recognize the characteristics of health care providers that offer a benchmark for excellence in patient safety internationally."

In accordance with this resolution, in 2004 the WHO established a Global Initiative for Patient Safety. The initiative comprises projects on cleaner care, safer surgery, reporting and learning from adverse events, and patient safety research. Research on the intervention project for safe surgery has attained remarkable results showing that the use of checklists in association with surgery may reduce mortality rates by 40% (33). A 2009 WHO report presents prioritized lists for research topics on patient safety. They have been made according to whether countries are developing, transitional or developed (5).

2.2 Patient safety research, concept, topics and priorities

So far we have seen how the issue of patient safety has gathered public interest. We will now look at how this has motivated patient safety research on how causes of adverse events and organizational risk may be identified and on how incidences of patient harm can be monitored.

Research on patient safety takes into account the context in which errors happen and seeks out actions that can prevent the errors from repeating themselves. Improvement of system design demands a non-punitive approach to errors and near misses. The underlying idea is that errors are system-driven. How does one eliminate the risk of cars crashing with trains? Not by warning drivers to look more carefully and punishing them more harshly for having been careless, but by building road bridges.

Since the year 2000 patient safety research has expanded rapidly. A March 2008 PubMed search for articles containing the words "patient safety" in five 5-year periods from 1983 to 2007 returns these numbers: 74, 153, 278, 962 and 3631. Specifically designated scientific journals have been established: Quality and Safety in Healthcare (established in 1992 as Quality in Healthcare; name updated in 2002), Journal of Patient Safety, Patient Safety and Quality Healthcare, and International Journal for Quality in Health Care.

Patient safety research is conducted along several lines and a number of tools have been developed for helping care-giving units prevent harm from happening to their patients. Methods for scrutinizing clinical processes and predicting risk in the interaction between patients, providers and technology have been adapted from other industries.

2.2.1. Failure modes and effect analysis and Probabilistic Risk Assessment

Failure modes and effect analysis (FMEA) identifies the potential effects of individual failures within an organized unit (34). It takes into account both the likelihood and the severity of a failure, identifies risks of harm and prioritizes preventive measures. To analyze what may go wrong in, for example, the process of delivering medicine by infusion, one characterizes each step in the infusion process and identifies how failures can happen in each step. Every step in the process is scored on a scale from 1 to 10, for the severity of failure if it is not detected, the likelihood of occurrence (based on experience, measurement, literature)

and the likelihood that the failure will not be detected before it causes harm (34). The aim of FMAE is to reduce the probability of failure to an acceptable level or to add safety mechanisms to mitigate the effects of failure (35).

Probabilistic Risk Assessment (PRA) investigates and models all combinations of process failures that may lead up to an imagined, undesired outcome (35;36). Events that contribute to adverse outcomes are analyzed through the use of event trees and fault trees. “Event Trees” map out the different pathways by which bad events can happen. The tree structure enables the analyst to see how one unwanted event leads to another. To include all potential pathways of failure the analysis depends on experience from experts from the context of the event one wants to mitigate. The graphic design helps the analysts to examine potential solutions effectively. Through “Fault Tree Analysis” the likelihood of event occurrence is determined. A fault tree resembles an event tree, but opens for adding probabilities of events that lead to an adverse event. Probabilistic Risk Assessment leads the analyst to areas of a system that may have safety related issues and indicates where to allocate resources for improvement. A realistic PRA model includes the variability of human behavior (36).

2.2.2. Root Cause Analysis

A retrospective method for analyzing causes of adverse events is Root Cause Analysis (RCA). The method assigns a team of clinicians, managers, and technicians to answer the following three questions: what happened, why did it happen, and what can be done to prevent it in the future? The method digs into the causes of adverse events and doesn’t accept as causes “violation of procedure” or “patient behavior,” but asks for the preceding causes. RCA relies on investigator experience and is best done by staff that is familiar with the scrutinized clinical issues. The search for system failure is often limited to one organizational level instead of across organizational levels. It tends to look for one single failure (the cause) rather

than a combination of failures, which has been a point of criticism. That is because an adverse event often is the result of many unfortunate circumstances which the health care provider, for several reasons, was not able to mitigate (37). The search for a single failure may inhibit the ability to acknowledge the complexity of factors contributing to an adverse event. The analysis may, however, lead to a better understanding of the causes of harm to patients and to preventive action (36;38).

2.2.3. Reporting adverse events

For reporting adverse events, the Aviation reporting system has been recognized as a relevant model for healthcare. Initially, one thought this routine would identify mechanisms for and indicate rate of patient harm. However, a study that compared an incident reporting system to medical record review showed that only 5% of harmful incidents were reported in the incident reporting system (39). Causes were interpreted to be fear of shame and litigation. Reporting systems are now only considered to be information sources for causes of patient harm, and not for their rate (40). They also provide the opportunity to accumulate and distribute knowledge on rare events so that whole healthcare systems may learn from one incident. A vulnerable point is how results of cause analysis are distributed. An effective infrastructure for information distribution is a success criterion.

Reporting routines make it possible for staff and management to audit significant events and identify mechanisms that have contributed to the incident. Informing patients and their families that such pitfalls have been removed may provide some consolation (41). Auditing significant adverse events may also have a debriefing effect on staff.

The designer, initiator and manager of the Aviation Safety Reporting System at NASA for 30 years, Dr Charles Billings, has the following advice to those who plan similar initiatives in healthcare: reporting should be confidential so that the informants are protected but may be

reached if more information is necessary, the reports should be richly narrated, and, to allow descriptions of nuances, analysts should have similar working experiences as those reporting. The reports should be collected and analyzed by an organizational body independent of management (42).

A well-functioning reporting system requires a blame free culture where causes of adverse events are sought in organizational structures rather than in failing individuals. This does not mean that individual responsibility does not matter, but focus should be on measures that can prevent disastrous effects from happening all because of one failing individual.

2.2.4. Structured medical record review

In order to know how safe hospital care is, the rate of adverse events needs to be measured. Since staff underreport incidents (39), the need for more reliable sources of data is evident. A challenge is to choose measurements that do not exclude patient groups on the basis of diagnosis in the way quality registers do, because they may divert the improvement effort toward the monitored patient groups on behalf of those that are not monitored.

The patients' medical records have until now provided the most reliable source of information on adverse events. It is obviously not perfect since this information is often not accounted for in the notes. But although care givers may leave out the information on adverse events in the notes, they will seldom omit treating the patient. In addition to the notes, the information must therefore be found in patient administrative data, lab data and in the information on what treatment has been given. The demand for such data has led to procedures for doing a structured medical record review (43). It was done in the Harvard Medical Practice Study, and has been replicated in its basic outlines in the UK, Australia, Canada and Denmark (1;44-49). The Institute of Healthcare Improvement (IHI) developed in 2003 a standardized way of doing medical record reviews: the Global Trigger Tool (GTT) (43). Since then, GTT has become a

tool that hundreds of hospitals in many countries use to reliably identify and track events directly related to patient harm. GTT quantifies and categorizes patient harm and is used to evaluate efforts to improve patient safety (50). The method relies on a review of a randomized sample of 20 medical records every month performed by a team of two nurses and one physician. The nurses search the sample, independent of each other, to filter out records with predefined triggers as displayed in Table 1; for example "INR > 6," "Glucose < 50mmol/l," or "readmission to ICU." Records with triggers are further examined to find out if harm has occurred. Identified harm is categorized and quantified.

Table 1

	Care Module Triggers		**Medication Module Triggers**
C1	Transfusion or use of blood products	M1	Clostridium difficile positive stool
C2	Code /arrest/ rapid response team	M2	Partial thromboplastin time greater than 100 seconds
C3	Acute dialysis	M3	Internationalized Normalized Ratio (INR) greater than 6
C4	Positive blood culture	M4	Glucose less than 50 mg/dl
C5	X-ray or Doppler studies for emboli or DVT	M5	Rising BUN od serum creatinine greater than 2 times baseline
C6	Decrease of greater than 25% in hemoglobin or hematocrit	M6	Vitamin K administration
C7	Patient fall	M7	Diphenhydramine use
C8	Pressure ulcers	M8	Flumazenil use
C9	Readmission within 30 days	M9	Naloxone use
C10	Restraint use	M10	Antiemetic use
C11	Healthcare associated infection	M11	Oversedation/ hypotension
C12	In-hospital stroke	M12	Abrupt medication stop
C13	Transfer to higher level of care	M13	Other
C14	Any procedure complication		
C15	Other		**Intensive Care Module Triggers**
		I1	Pneumonia onset
	Surgical Module Triggers	I2	Readmission to intensive care
S1	Return to surgery	I3	In-unit procedure
S2	Change in procedure	I4	Intubation/ reintubation
S3	Admission to intensive care post-op		
S4	Intubation/ reintubation/ BiPap in Post Anesthesia Care Unit (PACU)		**Perinatal Module Triggers**
S5	X-ray intra-op or in PACU	P1	Terbutaline use
S6	Intra-op or post-op death	P2	3rd- or 4th-degree lacerations
S7	Mechanical ventilation greater than 24 hours post-op	P3	Platelet count less than 50,000
S8	Intra-op epinephrine, norepinephrine. Naloxone, or romazicon	P4	Estimated blood loss> 500ml (vaginal) or >1000ml (C-section)
S9	Post-op troponin level greater than 1.5 ng/ml	P5	Speciality consult
S10	Injury repair, or removal of organ	P6	Oxytoxic agents
S11	Any operative complication	P7	Instrumented delivery
	Emergency Department Module Triggers	P8	General anesthesia
E1	Readmission to ED within 48 hours		
E2	Time in ED greater than 6 hours		

The time needed for the review is seven hours per month for the whole team –three hours per nurse and one hour for the physician. A change in the rate of adverse events over time is identified by using control charts. The method therefore demands continuity in the reviewing team to ensure stability in the way it is performed. The purpose is to enable hospitals, departments and clinical units to evaluate their patient safety over time.

2.2.5. Addressing patient safety culture

The milestone reports on patient safety acknowledge that making healthcare safer demands a change in leaders' and caregivers' awareness of adverse events, how they communicate about them and how they reflect and act on their causes (2;3;26;51). To be able to learn from adverse events, they have to be acknowledged. Acknowledgement of adverse events rests on a blame free atmosphere in the organization and its subgroups. A blame free atmosphere depends on leaders who are able and willing to analyze the extent to which incidents are system driven, and address system causes. The way leaders react to and reflect on adverse events must also be visible and predictable to staff. High staff turnover and low degrees of interaction between staff and leaders undermine this, because staff and leaders do not have the opportunity to learn about each others' values, priorities and attitudes.

Molding staff and leadership perceptions on adverse events involve what we call patient safety culture. The concept refers to individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that specifically determine an organization's commitment to and management of safety (52).

On a 2009 WHO list over the top five prioritized patient safety research topics, presented for each country category, patient safety culture is ranked as number three, in Table 2.

Table 2 WHO list of the top five prioritized patient safety research topics

Developing countries		Transitional countries	Developed countries
Rank	Research priority	Research priority	Research priority
1	Identification, development, and testing of locally effective and affordable solutions	Identification, development, and testing of locally effective and affordable solutions	Lack of communication and coordination
2	Cost effectiveness of risk reducing strategies	Cost effectiveness of risk reducing strategies	Latent organisational failures
3	Counterfeit and substandard drugs	Lack of appropriate knowledge and transfer of knowledge	Poor safety culture and blame oriented processes
4	Inadequate competences, training, and skills	Inadequate competences, training, and skills	Cost effectiveness of risk reducing strategies
5	Maternal and newborn care	Lack of communication and coordination	Developing better safety indicators

Mainstream research on patient safety culture builds on methods developed by organizational psychologists, mapping organizational values through questionnaires that assess perceptions of staff. Research from other industries show that staff perceptions on safety culture predict their safety behavior and incidences of unsafe events (12;53). Safety behavior that prevents harm needs to be continually requested and rewarded by leadership in order to be maintained (54). In this way, leadership can promote a good safety culture. Recent evidence indicates that this also applies to healthcare. Staff perceptions improve when leaders attend to patient safety culture (15).

Questionnaires that measure staff perceptions reflect only limited aspects of patient safety culture. Interesting aspects of how professions misinterpret each other's attitudes, behavior and priorities are not easily explored with these kinds of questionnaires. However, valid and reliable questionnaires make measurements of staff perceptions on patient safety available to top management. The information may be used to guide interventions. These may use a qualitative approach to explore further the causes of staff perceptions (55) in order to improve the patient safety culture.

3. Patient safety culture, concept and influences

Until now we have studied the development of a public concern for patient safety, how research in the field has evolved, and how the topic of patient safety culture research is a latecomer in this research. We will now explore how the theory of organizational culture and its concept of safety climate are foundations for patient safety culture research. We will study how safety climate can be applied to the context of healthcare and how it relates to teamwork and leadership.

3.1. Organizational culture – concept and influences

These paragraphs present the theoretical approach to organizational culture that is used in this thesis. A description of how the concept of organizational culture developed historically is included. How organizational culture is influenced by professional and national cultures, political context, and structural change in the organization is discussed.

Culture is the collective programming of minds which distinguishes members of one group in society from another (56). Such groups may be families, school classes, working groups, and organizations. The programmes are transferred from parents to children, from teachers to students and from leaders to subordinates as patterns of thinking about the world and their role in it. It is reflected in how the individuals evaluate and judge their own performances and those of others; in terms of being true or false, good or evil, beautiful or ugly. The culture determines how the individuals in the group interpret and give meaning to their experiences.

Organizational culture developed as a concept after the rise of Japan as a leading industrial power in the 1960's. Theorists believe that the ability to transform an industrial empire out of the ashes of the Second World War with no natural resources, no energy, and a large population in a crowded space is related to Japanese culture and general way of life. The

cultural values of the rice fields consist of relentless solidarity where one person's efforts are harvested by another and where all individuals are mutually interdependent in order to achieve an adequate result against all odds. The spirit of the samurai represents the individual that protects the workers from danger and coordinates the worker's efforts in a strategic and meaningful way (57). A recognized theory is that Japan's manufacturing organizations combine the cultural values of the rice fields with the spirit of the samurai to create an organizational culture that is particularly conducive to high quality mass production.

The concept of organizational culture relates to the lessons that members of an organization learn as they solve the organizations problems of survival, adaptation to an external environment, and of internal integration, over time (57). When, for example, a CEO prepares staff for moving into a newly built hospital at the same time as the organizational structure is radically changed, and says it will be like going on a bus ride, and "those who are not comfortable on the bus can just get off." The metaphor may perhaps be intended to tell the organization that the change could be an interesting experience but it also may be interpreted by employees to mean that those who want to speak up about problems with the process should rather leave their job.

Organizational culture is considered to consist of at least two layers. The visible outer layer manifests itself with observable behaviors, uniforms, meeting routines, reporting and greeting rituals. The inner layer consists of the values, perceptions, beliefs and underlying assumptions that provide references for members of an organization to interpret the behavior of others and to guide their own (58;59).

Behavioral rituals may be related to a dress code, choice of language and how one is expected to act in different situations. They determine how meetings are conducted, how budgets and plans are specified, how reports are issued and how experts are nominated. Sometimes the rituals better serve the purpose of symbolizing how power in a group is distributed rather than

the purpose of sound decision making (56). An example is the ritual for seating, which a resident experienced at the morning report meetings in an Anesthetic department. In the middle of the room there was a table where less than half the chairs were occupied. Along the walls were chairs that were all occupied. People preferred to stand along the walls rather than sit on the empty chairs at the table. The ritual did not serve the purpose of making people sit comfortably, but probably reflected how power and influence was distributed in the group. Leaders provide the basis on which group members model their culture by articulating beliefs, values and assumptions (59). The patterns of perceiving, thinking, feeling and behaving in the group provide meaning and stability, undermining anxiety from not being able to understand or predict events happening around the group. Because they provide emotional stability to their members, organizational cultures are difficult to change. An exception is when critical events occur. They provide unique opportunities to change an organizational culture in a short time. Leadership sets the standard for how the group finds it legitimate to react. If, for example, the leader immediately seeks to blame someone rather than to analyze the causes of the incident in a systematic way, the group learns that this is how they can expect their leader to react when such a crisis occurs. Norms and beliefs also arise around how the members in a group respond. Articulate group members, and those considered as role models may also have a significant impact on the group's culture. Union organizations and other professional and social networks of people within the organization contribute with their values and attitudes and represent subcultures within the organizational culture.

Because development of organizational cultures depends on shared experiences, one will find that large organizations; for example, hospitals, often have stronger organizational cultures at the subgroup level than at the hospital level (59). That may be because experiences at the group level are more easily shared than at the hospital level, which involves more people. One will also see that merging, a common experience to Norwegian hospitals, challenges

organizational cultures. Conflicts may arise if the values and assumptions of the merging cultures are not addressed in the process. A strong and supportive culture may be undermined by traumatic experiences that lead to distrust and disloyalty, which with time become unspoken assumptions. Healing wounds after traumatic experiences may be done by letting motivated insiders articulate underlying assumptions so that misunderstandings and conflicts are brought to the surface and can be addressed (59).

Organizational culture in public healthcare is also influenced by national policies that make up the organizations' financial and administrative systems. Values of these systems guide employee's behavior. An example is how the activity-based financing system in Norwegian public hospitals gives compensation for harmful iatrogenic incidents like fractures and infections occurring while patients are hospitalized. It does not provide incentives for leadership to reduce patient harm.

Organizational cultures are influenced by the national cultures of their members (58). Data from Taiwanese pilots who had filled out the Cockpit Management Attitudes Questionnaire (58) did not replicate the original factor structure, and items did not correlate as expected. Team trainers for pilots experienced that the concept of Crew Resource Management (CRM) seemed to make more sense in some countries and airlines than in others. This led researchers to explore further the impact national culture has on organizational culture in aviation. National cultures are influenced by restraints on resources and infrastructure, as well as history and different religious references. How national cultures differ is complex. By cross country research Hofstede has been able to detect some cultural elements that affect behavior in work. These are sorted into four cultural indexes (56). The Individualism versus Collectivism index indicates to what extent a national culture prefers a loose social framework giving a high degree of individual autonomy, compared to a tighter social framework demanding a higher degree of loyalty from the individuals but also higher promises of loyalty and care-giving in

return. In national cultures with low scores on this scale, disagreement is seldom directly expressed and tends to have a refined language of body and facial mimic. This has consequences for organizations that depend on subordinates to give direct communication and feedback. The Power Distance index indicates to what extent members of a society accept that power in institutions and organizations is distributed unequally. The Uncertainty Avoidance index relates to the emotional meaning of rules and reflects degrees of tolerance for uncertainty about the future. Strong Uncertainty Avoidance index societies demand high levels of control, rigid codes of belief and behavior, and are intolerant toward deviant persons and ideas. The Masculinity versus Femininity index shows a culture's preference for values like achievement, heroism, assertiveness and material success, on the masculine side , and on the feminine side, preference for relationships, modesty, caring for the weak, and quality of life.

Norwegian healthcare employs immigrant healthcare workers with a variety of national backgrounds. One should therefore assume that this influences how openly employees communicate with leadership when patient safety is at stake. When organizations adapt internationally recommended procedures and strategies they must be translated to a level of formalization and standardization acceptable to the national norms of the organizations' employees. That is why it is so important to validate translated questionnaires intended to, for example, measure patient safety culture.

The Power Distance (PD) scores also vary according to social status and educational level. Those with the highest levels of education and social status have the lowest PD scores. In a study on surgical teams in Switzerland, which is a low PD country, surgeons perceived the lowest power distance in their work relationships, followed by anesthesiologists, while the surgical and anesthesia nurses perceived a significantly higher level of power distance (58). Professional cultures contribute to safety by emphasizing responsible safety behavior and dedication to executing one's job effectively. On the other hand, a sense of invulnerability may

follow a professional culture, making pilots and physicians less aware of personal limitations and the need for training and safety precautions.

3.2. Safety culture – bridging leadership and safety behavior

As a branch of organizational culture, safety culture refers to individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that specifically determine the organization's commitment to and management of safety (52). The methodology for research on safety culture has been developed in the tradition of organizational psychology research and has mainly been performed in the manufacturing and high reliability industry. In this research, organizational culture is described by qualitative methods as well as expressed through quantitative surveys (6). Quantitative surveys have concentrated on measuring staff perceptions, which are referred to as organizational climates. Organizational climates are mathematical expressions of how members in natural social units perceive that cultural norms are enacted by leadership and members in the unit. If staff perceptions vary a lot, the mean value will give a less precise description of the climate in a unit, compared to where they are similar. Organizational climates are therefore measured both according to level of mean and the degree to which staff share the perceptions (60). The degree to which staff share the perceptions in the unit is a validity criterion for such measurements and is called the organizational climate strength. Organizational climates with diverging perceptions amongst staff are regarded as weak with limited power to predict staff practices (12). The mean of the staffs' climate perceptions in the unit is called the climate level.

Measurements of safety climate with the Safety Attitudes Questionnaire are often presented in terms of the percentage of staff that reports a good safety climate. This procedure provides information on both climate level and strength (16) . When safety culture is measured using questionnaires, the items are sorted into scales reflecting an array of organizational

dimensions relevant to safety, such as working conditions, teamwork climate and safety climate.

Safety climate is the extent to which employees perceive that safety is important to the organization (61). Zohar has shown that safety climate in operational units is influenced by safety priorities at organizational levels. In the high risk manufacturing industry, working units with a good safety climate had fewer safety mishaps and fewer absences from work. Safety climate at the top of the organization influenced safety behavior at the group level mediated by the safety climate at the group level. The degree to which tasks were formalized through procedures that limited individual assessment added to this influence (62). Measuring safety-oriented supervisory activity by repeated interviews with subordinates, and feeding the information back to the supervisors increased safety oriented interaction between supervisors and subordinates: Subordinate safety behavior and safety climate scores improved and minor injury rates were reduced (63).

In high risk units supervisors are likely to implement more rigorous safety procedures, and motivate more strongly for safety behavior than supervisors in units with lower risk. If safety procedures are not rigorously practiced in high risk units they will have lower group climate scores than the units with lower risk (64). This is reflected in the levels of patient safety culture in our study, which tended to be higher in wards and departments with lower risk (e.g., Neurology department, Medical department) compared to those with higher risk (e.g., the ER, and the Operation department).

Regardless of risk level, supervisors are likely to execute instituted procedures according to their own bias. Some supervisors will expect subordinates to assume greater responsibility for safety and emphasize this in their supervision; others will accept less responsible behavior from the subordinates. This explains the large variation in climate scores at the group level,

which is the background for our second hypothesis, where we assume that patient safety culture vary by ward and department and but more across wards than across departments. Individual differences also characterizes managers in higher hierarchical positions (64). Since organizational culture is influenced by leadership, it is relevant to consider the significance of different leadership qualities. Leadership quality may be categorized in a broad range of dimensions. Transformational leadership is value based and emphasizes individualized interaction, commitment and bonding between leaders and subordinates for the purpose of reaching challenging goals (64). When management at higher levels gives safety low priority, transformational leadership at the supervisory level is positively related to safety climate for employees. This may reflect both how transformational leaders in the manufacturing industry consider employee safety a moral obligation, even when it is not a declared priority by management. It can also indicate that interaction between leaders and staff facilitates sharing of values and priorities and produces a desired pattern of behavior. Transactional leadership is concerned with organizing tasks for reliable performance. The category is subdivided into the following three dimensions: constructive, corrective and laissez faire. Constructive leadership is less individualized than transformational, but still emphasizes subordinates' individual performance results, but with less weight on personal interaction. Constructive leaders only make a positive difference when safety has high priority from higher management levels (65). They are not driven by a personal connection to employees like transformational leaders are, and will give safety a priority only if it is demanded by senior management.

Corrective leadership is non individual, only identifying with the priorities of superior leaders. Corrective supervisors might even disregard imminent danger in favour of reaching production targets. This element of leadership is addressed in the following SAQ items: "Unit management doesn't knowingly compromise patient safety," where 49% of the total respondents in our

survey agreed and “Hospital management doesn't knowingly compromise patient safety,” where only 27% agreed (66). Less than half of the staff believed that leadership would not knowingly compromise patient safety, indicating an element of corrective leadership.

We will now interpret how junior physicians in our study perceived safety climate, in the context of leadership. As the table shows, the junior physicians perceived safety climate to be significantly worse than nurses, charge nurses and senior physicians (Table 3).

Table 3. Variation in mean perceptions amongst staff for Safety Climate

	Mean Score on factor scale	Charge nurses	Nurses	Senior Physicians
Safety Climate				
		p	p	p
Charge nurses (n 49)	69.0			
Nurses (n 623)	58.6	0.008		
Senior physicians (n132)	63.2	0.158	0.068	
Junior physicians (n 147)	53.8	0.000	0.041	0.001

Reasons for this may be that most junior physicians in Norwegian hospitals have little formal security of employment. Their time limited employment is regulated by law, in order to make sure that as few as possible stay longer in these assignments than necessary. The aim is to make as many physicians as possible get through the specialization programs. Combined with temporary assignments, three to six months at a time, junior physicians are seldom free to speak up and criticize conditions of patient care. If they do they may risk not having their assignment renewed, which would spoil their career and make their social situation difficult. At the same time, junior physicians play a crucial role by providing the bulk of patient care in hospitals. They admit them, read the reports from the referring physician, and decide what diagnostic examinations to perform and what treatment to give. At the end of the hospital

admission they write a report to the referring physician. If indicated, they refer the patient to another hospital. They are supposed to do this work under the supervision of consultants. In reality, the supervision depends on cultural elements like to what extent supervision is recognized as important by the leadership, the consultants' workload, and their attitude toward supervision. A trend in Norwegian hospitals for the past two decades has been that fewer consultants do rounds on inpatients in medical departments because they are scheduled for work in the outpatient departments. This leaves the junior physicians, the least experienced, with responsibility for the most sick and vulnerable patients. As previously mentioned, junior physicians in many specialties are not invited to meetings where organizational issues are on the agenda. This gives them little opportunity to inform leadership about how dysfunctional organizational routines and practices cause adverse events to patients. This may contribute to the situation we assume in our third hypothesis, that perceptions of safety climate are more positive the further away from the patients the employees work.

Apparently, the lacking opportunities that junior physicians have, to speak up about unsafe patient care, is not a Norwegian problem only (67). Based on theory presented in this chapter their low perceptions of patient safety climate could possibly be changed if their leaders and supervisors addressed the causes of adverse events through dialogue and interaction.

3.3. Cultural influences on patient safety

We have now considered research from other high reliability and manufacturing industries which shows that safety climate measurements to some extent predict safety behaviour and safety outcome (53). This relation is not equally well studied in healthcare. There is, however, some evidence that claims a connection between safety culture and climate measurements and patient outcome.

An observational study showed that team leaders that encouraged staff to speak up, and had few concerns related to power and status, were more successful in institutionalising minimally invasive cardiac surgery than their colleagues elsewhere (68).

In a study in the United Kingdom (UK), Mannion showed that National Health Services (NHS) hospitals with "clan" cultures are less likely to have high star ratings than "developmental" cultures. "Clan" cultures are characterized by tradition, loyalty, and coherence with emphasis on morale, while the "developmental" cultures are characterized by innovation, entrepreneurship, creativity and adaptation (69). Although the star rating system has been contested, the study resonates well with the Kennedy report on the public inquiry on children's heart surgery at the The Bristol Royal Infirmary (26).

The Kennedy report concluded that The Bristol Royal Infirmary was characterized by a "Club" culture: "Dr Roylance told his staff: `don't give me your problems, give me your solutions,'" "a system of separate and virtually independent clinical directorates, combined with a powerful message that problems were not to be brought to the centre for discussion and resolution, meant that there was power but no leadership," " the systems and culture in place were such as to make open discussion and review more difficult rather than more easy." It concludes: "There were a number of elements in the system and culture of management in Bristol which were conducive to the provision of less than adequate care," "the inadequacies of management were an underlying factor which adversely affected the quality and adequacy of care which children received." The report argues that the pathologic culture was not only a problem at the institution level but a problem in the whole NHS: "Trusts were to be allowed to get on with things. Senior managers were invited to take control, but little or no system existed to monitor what they did in the exercise of that control. Indeed, it did not really exist inside the Trust either, as Bristol suggested. The Chair and the Trust Board were either part of the 'club' or treated as outsiders." The Kennedy report gives qualitative evidence on cultural characteristics

believed to play an important role in paving the ground for adverse events that happened to children having heart surgery at the hospital.

The study by Mannion et al. shows that organizational performance in healthcare is linked to organizational culture. Case studies exploring this further found cultural problems related to the misalignment between professional values and practices, and changing demands and expectations in NHS policy. The high performing NHS acute trusts had robust systems for monitoring and improving organizational performance, with an informational infrastructure, capacity and performance management architecture to allow power and responsibility to move from the apex and toward frontline staff. The low performing acute trusts lacked strong directive planning and robust systems for information and performance management. Strong and empowered middle managers were found essential for the high performing acute trusts, which also paid particular attention to how they recruited, selected, promoted, retired or even fired staff. Because the worst cultural problems were experienced by low performing trusts, policymakers wanting to improve organizational culture were advised to take these experiences into consideration.

In a study of the relationship between the characteristics of hospitals, nursing units, work environments, and organizational and patient outcome, Hofmann found that safety climate in working units predicted urinary tract infections and medication errors occurring within the three following months. The effect of safety climate on medication errors was stronger when dealing with more complex patient conditions (11). Knowing that patients with complex conditions benefit even more is promising since they are also more prone to adverse events (1;49). The study is based on data from a larger study – the Outcome Research in Nursing administration project II. The results give reason to further explore the effect of safety climate intervention in healthcare.

In another study, two nursing climate scales were developed to measure key aspects of the nursing role--patient orientation, professional development and teamwork, all known to have impacts on patient safety (12). One scale, The Hospital Nursing Climate Scale, was made to measure how policies and practices by senior management supported the dimensions. The Unit Nursing Climate Scale was designed to measure how nurse managers and peers practiced the same three dimensions at the unit level. Medication safety was measured with a 12 item checklist for routine practices associated with medication storage, expiration dates, post administration records, patient identification and bedside administration. Emergency safety was measured with three items covering replenishment of medical supplies, updating of records and authorization renewals according to emergency procedures. Both hospital climate and unit climate levels predicted results in the patient safety data collected six months later. Hospital climate and unit climate levels were significantly correlated. There was also a significant interaction between the two climates. When both were high, patient safety was at its highest level. When hospital climate was low, the effect of unit climate on patient safety practices became stronger, indicating that unit level managers can compensate for deficient organizational level priority of patient safety (12). The results propose that leadership at senior and local levels interact in creating a safety climate that supports or undermines safety behaviour at the frontline. A weakness of this study's design is that it only measures a limited number of dimensions of safety culture.

In applying the concept of patient safety culture in healthcare, questionnaires have been developed to measure staff perceptions on dimensions relevant to patient safety. The Safety Attitudes Questionnaire, which is used in this thesis, is developed by Bryan Sexton, together with Robert Helmreich (9). The questionnaire maps six dimensions of safety culture related to patient care: Safety Climate, Teamwork Climate, Stress Recognition, Perceptions of

Management, Working Conditions and Job Satisfaction. In patient care settings safety culture is often referred to as patient safety culture.

Questions asked are, for example, “I am encouraged by my colleagues to report any patient safety concerns I may have,” and “I would feel safe being treated as a patient here.” Examples questions asked to address how the teamwork climate supports frontline workers are, “The physicians and nurses here work together as a well-coordinated team,” and “Disagreements in this clinical area are resolved appropriately (i.e., not who is right, but what is best for the patient).

3.4. Teamwork climate and patient safety

We have now seen that organizational cultures influence healthcare outcomes, including patient safety. This relationship can be expressed numerically by measuring staff perceptions in organizational climates. One example is teamwork climate. In the following paragraphs we will explore how teamwork climate is related to patient outcome and is influenced by organizational infrastructure. We will introduce the concept of “Microsystems” and “Mesosystems” and look at how teamwork climate relates to professional culture and power distance. First, we take a look at a relevant case.

One night a man in his fifties was admitted with hypoxy, circulatory unstableness, no signs of ischemia in the ECG, D-dimer was high and there was pleural effusion on the X-ray of the lungs. At a recent meeting in the clinic we had discussed and agreed that we should treat severe cases of acute pulmonary embolism with thrombolytic therapy. But before doing this the diagnosis had to be confirmed with spiral CT. This was agreed on without informing or making agreements with the radiology department, which would have to be prepared to do this examination around the clock. The radiologists had sleeping duty at home in the night. I assessed that this patient should be considered for thrombolytic therapy, but hesitated to

contact the radiology department to ask for a spiral CT because I knew I would meet hostile comments about this not being according to their procedure. The radiologist on duty was at home and would want to come only if it was highly indicated. Having many other tasks coming on, it was easy for me to push this uncomfortable problem aside and just order standard anticoagulation treatment and think I could sort out the question of thrombolytic therapy when I had more time to plan my arguments for requesting the radiologist to do the examination. The nurse from the ICU called. He had heard about the discussion in the physicians' meeting and knew about the conclusion ─ to treat severe acute cases of PE with thrombolytic therapy ─ and he asked me why I had not ordered it. I told him that I hesitated because I thought it would be difficult to get the radiologist to do the Spiral CT at night since it was against their usual procedure. He urged me to proceed. I called the radiology department and found that the radiologist already was there for a surgical procedure. His counter-argument was that this case introduced a new principle to their practice that would imply more active duty at night for their department. Although he was reluctant, he accepted that the spiral CT was necessary for confirming the diagnosis before we gave thrombolytic therapy. The diagnosis was confirmed with spiral CT and the patient was given thrombolytic therapy with a successful result. I am glad the nurse urged me to confront the radiologist in the middle of the night, but it would have been easier if this question already had been sorted out by leaders from the medical and radiology departments.

The case demonstrates how teamwork is an issue across both boundaries of hospital professions, and departments, and that it is highly related to the SAQ's teamwork climate items which are: "Nurse input is well received in this clinical area," "In this clinical area, it is difficult to speak up if I perceive a problem with patient care," "Disagreements in this clinical area are resolved appropriately (i.e., not who is right, but what is best for the patient)," "I have the support I need from other personnel to care for patients," "It is easy for personnel here to

ask questions when there is something that they do not understand," and "The physicians and nurses here work together as a well-coordinated team." The case demonstrates how teamwork climate is relevant for patient safety.

The link between teamwork climate and patient safety outcome was particularly addressed in the Keystone project, an intervention to improve safety culture in 99 ICUs in Michigan. First, the project measured safety culture with the Safety Attitudes Questionnaire. A broad set of interventions were implemented, including tools for teamwork improvement: a daily goals sheet, morning briefings and shadowing of other disciplines. The latter means when a person from one profession observes a person from a different profession at work. The aim is to learn how tasks of the other profession depend on the tasks of the observer's profession. ICU staff were challenged on what they could do to improve teamwork among physicians and nurses. At baseline, teamwork climate varied significantly among the ICUs, ranging from 16% to 92% percent of caregivers reporting good teamwork climate. 17% of the ICUs had a >= 60% consensus on good teamwork. After the intervention 46% of the ICUs had a >= 60% consensus or a 10 point improvement on good teamwork (70). The intervention also resulted in a significant reduction of catheter related blood stream infections (71). The evidence from the study indicates that the Safety Attitudes Questionnaires is externally valid.

When discussing teamwork across boundaries of departments, it is relevant to introduce the concepts of "microsystems" and "mesosystems." A microsystem refers to a group of clinicians and of staff working together with a shared purpose to provide care for a population of patients (72). A mesosytem is a model which integrates the care delivery process between contributing microsystems defining a new mesosystem leadership for each patient population (73). The previously mentioned case of the patient with pulmonary embolism shows how teamwork is influenced by contracts and agreements at the department level; the radiologist was unwilling to do a procedure at night without support from his leadership that this was a

valid use of resources. The need for coordination of leadership between departments is addressed in the model of mesosystems, which serve specific patient populations, often based on diagnosis. Patients with several chronic conditions would probably be more difficult to care for in such an organizational structure, if it does not specifically address their potentially complex demands. They are more prone to adverse events and need a broad approach that includes several specialties, with the capacity to sort out and coordinate the professional priorities amongst them. Geriatric units may perhaps be the closest one comes to such an organizational structure. Still, one should not forget that not all patients with more than one chronic condition are elderly. The fact that patients with complex conditions are also vulnerable to experiencing adverse events (49) is perhaps the reason why "how to improve communication and coordination," is rated highest on WHO's list over research priorities on patient safety (5). As the case of the pulmonary embolism demonstrates (page 48), frontline caregivers may find themselves in situations where they have to advocate for the needs of their patients. If this advocacy is left to less experienced staff, like, for example, junior doctors, with little impact on such ad hoc negotiations, it may threaten patient safety. Deciding which patients to prioritize is a frequent scenario in healthcare, where limited resources have to be distributed amongst sometimes endless demand. To combat such ambiguity it would help if leaders sort out priority problems that may arise, and communicate clearly how they should be handled. This demands adequate meeting routines both at the leadership level and between leaders and frontline staff. As earlier mentioned, such routines are not well implemented in Norway.

3.4.1. Perceptions of teamwork across professions

In the previous paragraphs we have considered how organizational infrastructure and leadership priorities influence teamwork climate. We will now examine how perceptions of teamwork may differ between professions.

A study performed in eight non surgical intensive care units in Houston, Texas examined how critical care physicians and nurses perceived teamwork in their working unit (74). 73% of the physicians rated the quality of collaboration and communication with the nurses as high, while only 33% of the nurses rated the quality of communication and collaboration with the physicians as high. Nurses found it more difficult to speak up if they perceived a problem with patient care, and their mean scores on perceptions of how "input from ICU nurses about patient care was well received in the unit" were significantly lower than those of the physicians. Nurses agreed significantly more ($p <= 0.01$) than physicians on the item: "Decision-making in our ICU should include more input from other ICU personnel than it does now." A simple interpretation of the results is that the two professions have different perceptions of what a good teamwork climate is; physicians believe it to be when nurses do as they are told. To nurses, a good teamwork climate is that they are asked for information about the patient that they believe is relevant for treating them. In our data from Akershus University Hospital we found a significant difference between the fractions of physicians and nurses that agreed on that collaboration with the other profession was good. 84% of the physicians (N=19) rated the collaboration with nurses as good, while only 40% of the nurses (N=74) rated the collaboration with physicians as good. Similar results have been found in American operating units and in labor and delivery units (75).

We did not find the same result studying all the somatic care giving units as a whole; 75% of the physicians (N=238) rated the collaboration with the nurses as good while 71% of the nurses (N=531) rated the collaboration with the physicians as good. We therefore suggest that

ICUs may have greater challenges concerning teamwork climate than other somatic wards. The reasons may be related to the cultural issue of power distance, as described in the work of Hofstede (56). He found that occupations with lower status and educational level have higher power distance scores, indicating a higher tolerance for unequal distribution of power in a hierarchy, than occupations with high status and educational level (58). In Norway, nurses working in ICUs are specialized and therefore on a higher educational level than nurses in ordinary wards. This may reduce ICU nurses' acceptance of unequal distribution of power over clinical decision-making in teamwork with physicians, compared to nurses in other wards.

Differences between nurses and physicians perceptions of collaboration with the other profession may also be related to their professional cultures, which may give them different expectations on how the professions should interact. Such differences could be sorted out by facilitating dialogue across the professional boundaries, with for example the Safety culture check up tool (55).

3.5. Leadership influences on patient safety culture

So far we have discussed how the new approach to patient safety research has evolved, how patient safety research has adopted the concept of safety climate, and how safety climate research is developing in healthcare. We have seen that efforts have been made to validate measurement scales and analytical instruments used for identifying patient safety problems. A challenge that remains is to validate strategies to improve patient safety culture. Designs for some leadership strategies have been tested and the influence of hospital boards on patient safety has been studied.

The Comprehensive Unit Based Safety Program (CUSP) was developed to improve patient safety culture in care giving units. It consists of six steps: assessing safety culture; science of

safety education; staff identify and prioritize safety concerns; senior executives adopt a unit; improvements implemented from safety concerns; efforts and results documented and analysed every month and results shared; and culture reassessed. A cornerstone in CUSP is that top leaders commit themselves to be part of an improvement team in the unit they partner with, and meet once a month to discuss improvement strategy and results with the group.

CUSP was successfully implemented in the Keystone project, which included all hospitals with ICUs in Michigan. The intervention resulted in a 60% reduction of catheter related infections, as well as improvements in safety culture (21;70).

A different strategy for safety climate improvement is the Leadership Walk Rounds model (76;77). Leadership Walk Rounds engage executives in dialogue with care-givers to identify patient safety hazards and to choose how to improve patient safety. The program demands a rigorous approach to elicit care-givers' concerns about patient safety, near misses and adverse events, and should not be exchanged with ordinary leadership visits of a more superficial character. Walk Rounds have to be well prepared, with schedules planned, participants trained, data collection prepared, and with resources to process and feed back information and measurements of safety climate.

A prospective intervention study was conducted to implement Leadership Walk Rounds in seven hospitals. Four of the seven hospitals complied with the weekly Walk Rounds but only two of them collected evaluation data systematically. Data from 21 patient care areas in the two hospitals was included in the analysis. At baseline, 48% of the care areas had safety climate scores below 60%. After Walk Rounds, 14% had safety climate scores below 60% without improving by 10 points or more.

The intervention showed that Walk Rounds requires a significant amount of organizational will, and outstanding leadership engagement. When rigorously implemented, they improve safety climate and themes for improvement are identified.

The significance of leadership for improving patient safety culture is emphasized by the roles of leaders in both the CUSP and Leadership Walk Rounds models. How executive leadership influences safety climate has also been the focus of research in domains other than healthcare. In a study Zohar performed in 36 small to medium manufacturing plants in the metal, food, plastics and chemical industry, organization-level safety climate was compared to safety climate measurements at the group level. Examples of items used at the organizational level were: "Top management reacts quickly to solve the problem when told about safety hazards," "Top management provides all the equipment needed to do the job safely," "Top management listens carefully to workers' ideas about improving safety," "Top management is strict about working safely when work falls behind schedule," and "Top management gives safety personnel the power they need to do their job." Group level climates were measured with items like: "My direct supervisor makes sure we receive all the equipment needed to do the job safely," "My direct supervisor discusses how to improve safety with us," "My direct supervisor spends time helping us learn to see problems before they arise," and "My direct supervisor says a 'good word' to workers who pay special attention to safety." In this study, safety climate at the organizational level correlated significantly ($p < 0.01$) with safety climate measured at group level. Safety climate at organizational level also predicted safety behaviour at group level ($p < 0.001$) after controlling for risk. The effect of safety climate at the organizational level on safety behaviour was eliminated after controlling for group-level climate and risk, showing that the effect of organizational climate on safety behaviour is mediated by safety climate at group level (62). The study concludes that top leadership states the formal policies of an organization while leadership at lower levels interprets and enacts these policies in a context of competing operational demands. The behavioural consequences are then influenced by how staff expect to be rewarded or sanctioned for their safety behaviour. In this way, group level safety climate motivates role behaviour likely to be recognized and rewarded. Supervisors that constantly let

production pressure undermine practice of safety routines will yield low safety climate levels and a higher probability of adverse events. Supervisors will, on the other hand, be under the influence of executive leadership. Group level climate variation will depend on how consistently executive leaders enforce their policies. Executive leadership has a larger impact when it is strong (62). Since safety climate is positively influenced by the quality of interaction between leadership and subordinates, the importance of dialogue between leaders and frontline workers cannot be overemphasized.

3.5.1. Leadership priorities and patient safety

One of the initiatives in the Keystone project (21) was to optimize ICU physician staffing. The measure highlights the significance of infrastructure. A study from Maryland shows how patient safety is influenced through priorities related to infrastructure. Information was gathered from discharge data on abdominal aortic surgery patients, and from medical directors of the ICUs that had cared for them. Organizational characteristics in the ICUs were related to variation in patients' risk-adjusted morbidity and mortality following abdominal aortic surgery (78). ICUs that did not have daily rounds by physician specialists had a 3-fold increase in hospital mortality, as well as a 2- to 3-fold increased patient risk for a number of complications including cardiac arrest, acute renal failure, septicaemia, platelet transfusion, and re-intubation. Patients at ICUs with one nurse caring for three or more patients, compared to units with one nurse caring for one or two patients, were at increased risk of specific pulmonary complications, including pulmonary insufficiency after a procedure, and re-intubation of the trachea.

How patient safety is influenced by the priorities of executive leaders was recently studied by comparing board practices on quality oversight with hospitals' quality and safety performances.

Quality performance was measured in both process of care and outcomes (20). An example of process of care measure for heart attack was if patients had received aspirin, provided there was no aspirin contraindication, within 24 hours before or after hospital arrival. Hospital-level risk-adjusted mortality rates for heart attack, heart failure and pneumonia were measured as outcome measures. 490 hospitals were included in the study. Significantly better processes of care scores and lower risk-adjusted mortality rates were found for hospitals that had a special board committee focusing exclusively on quality rather than for hospitals that did not. The hospitals that had the CMO/VP of medical affairs on the board quality committee had significantly higher processes of care scores and significantly lower risk-adjusted-mortality than hospitals that did not have the CMO/VP of medical affairs on the committee.

Hospitals that had 'clinical quality', 'patient safety' and 'patient satisfaction' as parameters on their dashboard had significantly higher scores in processes of care and lower risk adjusted mortality rates than the others. The hospitals that had a specific item on the board agenda devoted to quality, in most of their meetings showed significantly better scores in processes of care and lower mortality rates. Hospitals that included measures of quality and safety in the performance evaluations of CEOs showed significantly better scores in processes of care and lower mortality rates.

The two studies described above show how organizational characteristics at both the care giving and governing level relate to the safety of patient care. Although they represent limited evidence, their results suggest that patient safety culture is related to leadership priorities to ensure organizational support for patient safety.

This is consistent with the experiences of the Institute of Healthcare Improvement (IHI) in the 100K lives campaign. They found that the organizational context was more conducive to improvement in hospitals that excelled in patient safety results (79). Based on this experience and emerging research evidence, IHI identified properties that hospital boards can develop to

improve their approach to patient safety. This resulted in a guide for "Getting boards on board," IHI's slogan for its recent 5 million lives campaign (79). The campaign set the target of reducing 5 million incidents of patient harm in hospitals from 2006 to 2008. It recommended 12 interventions, of which only one was non-clinical: to engage governing leadership in quality and safety.

To engage top management in quality and safety IHI recommended that boards in all hospitals undertake six key activities to reduce patient harm:

- Set an aim to reduce harm to a specific level
- Review last period's progress toward safer care as the first agenda item at every board meeting
- Identify a small group of organization-wide "roll-up" measures of patient safety, update the measures continually and make them transparent to the entire organization
- Commit the organization to establish and maintain a safety culture that is respectful, fair, and just
- Oversee execution of a plan to achieve aims to reduce harm, including executive team accountability for clear quality improvement targets.
- Boards should spend at least 25% of their meeting time on safety issues, and regularly invite a patient, or a family member of a patient, who has experienced serious harm at their institution within the last year.

4. Measuring patient safety culture

Although the science of patient safety culture is very young, the interest in applying the evidence it produces is high. In its "Leadership Guidelines to Patient Safety," the IHI recommends doing safety culture surveys as an early step in strategies for improving patient safety. The purpose of establishing a baseline for patient safety culture is to be able to offer appropriate intervention to care-giving units that struggle with it (80).

In this chapter some of the most frequent approaches for acquiring information about patient safety culture are outlined. Although the most conventional way of gathering information about patient safety culture is by doing surveys, there are also other approaches. A broader presentation is given of the Safety Attitudes Questionnaire (SAQ), on which this thesis is based.

4.1. Qualitative approaches to patient safety culture

Confidential inquiries, analysis of adverse events, audits, patients' liability claims, semi-structured interviews, focus group interviews, story telling, observation and Leadership Walk rounds are examples of sources of qualitative information on patient safety culture. Although many presume that patient safety culture is a relevant subject for qualitative research, not many have been conducted. An example of such a study from an operating theatre showed how doctors and nurses had different opinions on the safety benefits of rules and guidelines (81). Doctors found that patient safety sometimes benefited best by breaking rules while nurses found that patient safety was threatened by doctors breaking rules. Such issues are not captured well in quantitative surveys, although they may contribute to their results and therefore are important to recognize. The strength of qualitative methodology is that it identifies staff beliefs, attitudes and patterns of behaviour and provides an opportunity for them to discuss and review these. A group exercise, following quantitative surveys, where staff in the units discuss and

interpret the meaning of survey results in the context of the unit's practical daily life, may reveal qualitative issues that are important for improving the unit's patient safety culture (55).

4.2. Semi-quantitative questionnaires

Questionnaires have been made to help selected groups of staff identify and discuss problems with patient safety culture without quantifying them. The following questionnaires are examples of this.

The Manchester Patient Safety Framework (MaPSaF)

The Manchester Patient Safety Framework (MaPSaF) is a tool specifically developed to help healthcare organizations assess their progress in developing a safety culture (82). It is a structured guide that facilitates a group or a team to discuss and assess the organization's maturity concerning ten different dimensions relevant to patient safety. The dimensions are: 1) Commitment to overall continuous improvement; 2) Priority given to safety; 3) System errors and individual responsibility; 4) Recording incidents and best practice; 5) Evaluating incidents and best practice; 5) Learning and effecting change; 7) Communication about safety issues; 8) Personnel management and safety issues; 9) Staff education and training; 10) Teamwork. How staff members assess the organization within these dimensions is expressed on a scale called "The maturity scale." It stretches from Pathological (Why do we need to waste our time on patient safety issues?), through Reactive (We take patient safety seriously and do something when we have an incident), Bureaucratic (We have systems in place to manage patient safety), Proactive (We are always on the alert/thinking about patient safety issues that might emerge), to Generative (Managing patient safety is an integral part of everything we do). MapSaf is intended as a facilitative tool, not as a performance indicator. It pinpoints and facilitates discussion on problems with patient safety culture in the organization. There are no reports on

results from using the tool and it is not validated, although it is the most widely used safety culture tool in the United Kingdom (83).

The "Strategies for Leadership ─ an Organizational Approach to Patient Safety" (SLOAPS)

The purpose of "Strategies for Leadership ─ an Organizational Approach to Patient Safety" (SLOAPS) is to help health care organizations evaluate their patient safety culture and identify areas for improvement. It is completed by a multidisciplinary team consisting of a minimum of six individuals from frontline care, middle and top management. The questionnaire consists of 53 items describing how patient safety is prioritized in six areas of management: 1) Leadership, 2) Strategic planning, 3) Information and analysis, 4) Human resources, 5) Process management and 6) Patient and family involvement. The responders assess the extent to which the organization has achieved key aspects of patient safety; for example: 1) Patient safety is demonstrated as a top leadership priority; 2) The organization promotes a non-punitive culture for sharing information and lessons learned; 3) The organization routinely conducts an organization-wide assessment of the risk of error and adverse events in the care delivery process; 4) Adverse events are analyzed to identify trends across events; 5) Reporting errors and safety driven decisions are rewarded and recognized; 6) Effective teamwork disregarding team members' position of authority is fostered. Care delivery that avoids reliance on memory and vigilance is implemented. The tool is not validated and there are no reports on its use.

The "Checklist for Assessing Institutional Resilience" (CAIR)

The "Checklist for Assessing Institutional Resilience" (CAIR) instrument is intended to map organizational activity to increase their "resistance" to adverse events. It is a 20 item "wish list" of desirable features of a high reliability healthcare organisation for combating dangers to patients posed by human fallibility and systemic shortcomings (84). The items are process measures that reflect commitment, competence and communication to direct the institution's

policies, procedures and practices in a proactive direction for preventing patient harm. Examples are: Safety-related issues are considered at high-level meetings on a regular basis, and not just after some bad event; Top management anticipates that staff will inevitably make errors, and trains them to detect and recover them.

4.3. Quantitative surveys

A number of questionnaires for quantitative surveys exist (52), including the "Hospital Survey on Patient Safety Culture" (HSOPS) (85), the "Veterans' Administration Patient Safety Culture Questionnaire" (VHA PSCQ) (86), the "Culture of Safety Survey" (CSS) (87) and the "Safety Attitudes Questionnaire" (SAQ) (9;88). Reviews of a number of the most widely used quantitative safety culture survey instruments are presented by Colla, Bracken, Kinney and Weeks , and by Flin, Burns, Mearns, Yule and Robertson (89). In Table 4, an example of such a review is presented. The review includes SLOAPS, which we in this thesis consider to be a semi quantitative questionnaire because it does not result in data that can quantify staff perceptions but topics relevant for discussion in the units that fill it out.

The "Hospital Survey on Patient Safety Culture" (HSOPS)

The "Hospital Survey on Patient Safety Culture" (HSOPS) was released by the Agency for Healthcare Research and Quality (AHRQ), US Department of Health and Human services, in November 2004. It assesses hospital staff opinions about patient safety issues, medical error, and event reporting. It includes 42 items, which measure 12 dimensions of patient safety culture.

Table 4

Patient safety climate surveys: summary of characteristics

	Name of survey								
	SLOAPS	**PSCHO**	**VHA PSCQ**	**HSOPS**	**CSS**	**SAQ**	**SCS**	**MSSA**	**HTSSCS**
Setting appropriate for use	General	General	General	General	General	Multiple units	Multiple units	Pharmacy	Transfusion
General characteristics									
To be completed by individuals	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
No of items (demographics not included)	58	82/32	71	42	34	60	19	194	27
Uses 5-point Likert scale	Yes	Yes	Yes	Yes	Partial	Yes	Yes	Yes	Yes
Measures implementation of actions	Yes	No	No	No	No	No	No	Yes	No
Common dimensions covered									
Leadership	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Partial
Policies and procedures	Yes	Partial	Yes	Partial	No	Partial	Partial	Yes	Partial
Staffing	Yes	Partial	Yes	Yes	Partial	Yes	Partial	Yes	No
Communication	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Reporting	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total no of dimensions	9	5 (16)	13	12	4	6		20	8
Psychometrics performed									
Item analysis	No	Partial	Yes	Yes	No	Yes	Partial	No	Yes
Exploratory factor analysis	No	No	Yes	Yes	No	Yes	No	No	Yes
Confirmatory factor analysis	No	Yes	Yes	Yes	No	Yes	Partial	No	Yes
Cronbach's alpha	No	No	0.45–0.90	0.63–0.83	"Poor"	0.68–0.81	"Good"	0.44–0.84	0.61–0.85
Test/retest reliability	No	No	No	No	Yes	Yes	Partial	No	No
Correlated composite scores across dimensions	No	No	Yes	Yes	No	Yes	No	Partial	Yes
Analysis of variance across services	No	Yes	No	Yes	No	Yes	Yes	Partial	Yes
How used in studies									
Intra institutional comparisons	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Inter institutional comparisons	No	Yes	No	Yes	Yes	Yes	Partial	Yes	Yes
Inter industry comparisons	No	Yes	No	No	No	Yes	Partial	No	No
Association with reporting rates	No	No	No	Yes	Yes	Yes	No	Yes	No
Association with process measures	No	No	No	No	Yes	Yes	No	No	No
Association with patient outcomes	No	No	No	No	No	Yes	No	No	No
Pre *v* post intervention studies	Partial	No	No	No	No	Yes	No	No	No

SLOAPS, Strategies for Leadership: An Organizational Approach to Patient Safety;[16,24,31] PSCHO, Patient Safety Cultures in Healthcare Organizations;[25,32] VHA PSCQ, Veterans Administration Patient Safety Culture Questionnaire[19] (McKnight and Lee, unpublished data, September 2001); HSOPS, Hospital Survey on Patient Safety;[21,33] CSS, Culture of Safety Survey;[18] SAQ, Safety Attitudes Questionnaire;[22,23,26,34–39] SCS, Safety Climate Survey[40] (10 item version called Safety Climate Scale[24,40]); MSSA, Medication Safety Self Assessment;[17,41] HTSSCS, Hospital Transfusion Service Safety Culture Survey.[20]

The questionnaire is now widely used across the US and is increasingly being used worldwide. A database is provided to enable comparison between hospitals and to examine trends in patient safety culture over time. Reports on the psychometric properties of the questionnaire (85;90) are based on population samples, where criteria for sample selection vary as well as the response rate. In the pilot study, strategic samples from six hospitals were used to ensure representation of an adequate variety of job categories and hospital units, while only nurses and pharmacists were included from four other hospitals, and they were randomly chosen. The overall response rate was only 29%.

The "Veterans' Administration Patient Safety Culture Questionnaire" (VHA PSCQ)

The "Veterans' Administration Patient Safety Culture Questionnaire" (VHA PSCQ) is a forerunner to the HSOPS and results from a survey using this questionnaire had significant influence on the safety culture dimensions and types of items that were included in the pilot version of the HSOPS.

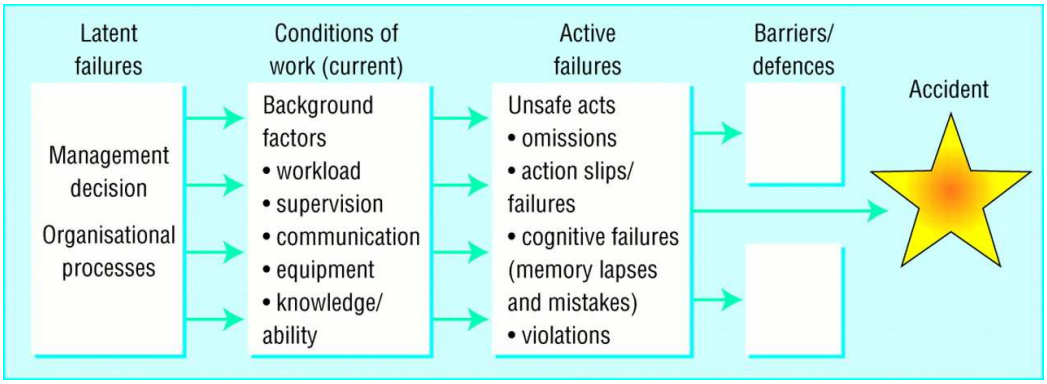
The "Culture of Safety Survey" (CSS)

The "Culture of Safety Survey" (CSS) is a modified version of the Stanford/PSCI culture survey. It was developed to survey patient safety culture at the hospital level of 15 Californian hospitals, in the four health care regions of Manitoba, Canada, in the fall of 2007 (86;91). The questionnaire includes items in seven dimensions: 1) organizational leadership for safety; 2) unit leadership for safety; 3) perceived state of safety; 4) shame and repercussions of reporting; 5) safety learning behaviours; 6) reporting culture; and 7) learning culture. It has been used to differentiate safety culture at both the hospital level and group level, not regarding recommended validity criteria for climate measurement (92).

The Safety Attitudes Questionnaire (SAQ)

The Safety Attitudes Questionnaire is a further development of the Intensive Care Unit Management Attitudes Questionnaire (10;74). It was originally derived from the Flight Management Attitudes Questionnaire (FMAQ) (93), a measuring instrument to model features of aviation safety culture, with a 20-year history in aviation (9). The SAQ consists of items both from the FMAQ, and new items generated on the basis of Vincent's framework for analysing risk and safety (94) and Donabedian's conceptual model for assessing quality (95). Vincent's framework for analysing risk and safety systematically presents factors that influence safe performance in clinical practice. The framework is illustrated by the chain presented in Figure 1, showing how the factors interact.

Figure 1



Reproduced from [Framework for analysing risk and safety in clinical medicine, Vincent, C, Taylor-Adams,S, Stanhope, N, BMJ Apr 1998; 316: 1154 - 1157, Copyright © 1998] with permission from BMJ Publishing Group Ltd.

The framework incorporates the following factors and serves as an analytical instrument for exploring causes of adverse events:

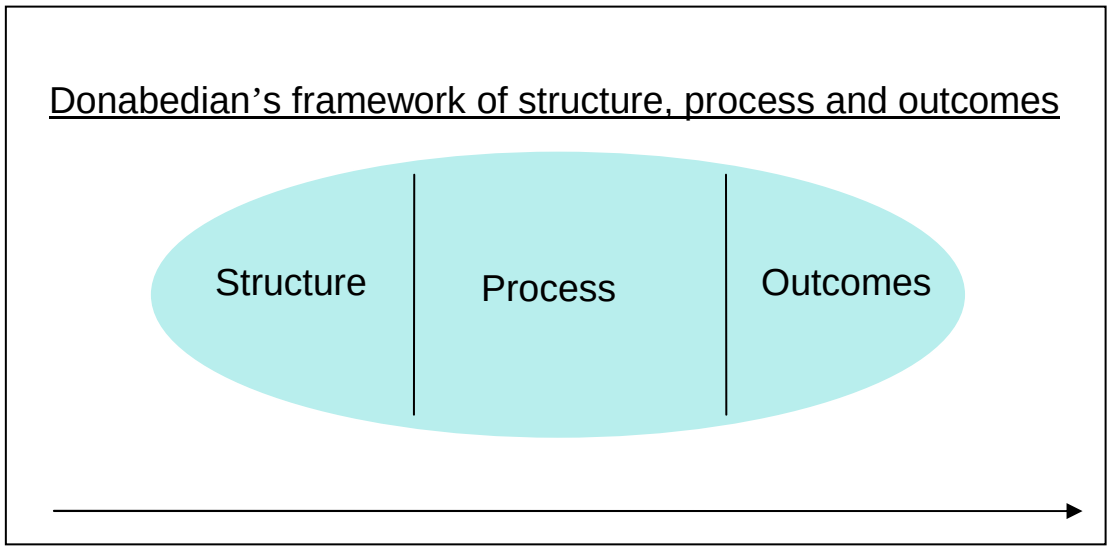
- **Institutional context**, including financial system, and regulations
- **Organizational and management factors**, organizational structure, financial resources and constraints, safety culture and priorities
- **Work environment**, staffing levels, skills, workload and shift patterns. Design, availability, and maintenance of equipment. Administrative and managerial support.
- **Team factors**, communication, supervision, team structure
- **Individual factors**, knowledge and skills, motivation, physical and mental health
- **Task factors**, design and clarity of structure, availability and use of protocols, availability and accuracy of test results
- **Patient characteristics**, condition, complexity and seriousness, language and communication, personality and social factors

It gives organizations a conceptual overview enabling them to think systematically about their risk of experiencing adverse events and to develop instruments to assess this risk. SAQ is an example of such an instrument.

Donabedian's conceptual model not only addresses quality of patient outcome but also how processes of care and physical and organizational infrastructure contribute to it (95). As

described in Figure 2, it suggests that good structure increases the likelihood of good process which again increases the likelihood of good outcomes. The model is motivated by the idea that clinical results may be improved by revealing and addressing inadequate organizational infrastructure and clinical processes. The approach enables the assessment of the determinants of outcome in addition to the clinical outcome itself (96).

Figure 2



The model of structure, process and outcome has been applied with success in other industries like, for example, automobile manufacturing, where the Toyota Production System is a point of reference (97). Identifying inadequacies in organizational infrastructure before they lead to adverse events is a proactive approach that gives opportunities for further quality improvements in healthcare. The model represents a change from inspecting to promoting the quality of clinical results. In this approach the Safety Attitudes Questionnaire (SAQ) is a relevant measure, since it maps staff attitudes both toward hospital infrastructure ("All the necessary information for diagnostic and therapeutic decisions is routinely available to me," "The levels of staffing in this clinical area are sufficient to handle the number of patients")

and processes of care-giving ("The physicians and nurses here work together as a well-coordinated team").

The items of the SAQ were evaluated through pilot testing and exploratory factor analysis, which led to identification of the following six factors: 1) Safety Climate, 2) Teamwork Climate, 3) Stress Recognition, 4) Perceptions of Management, 5) Working Conditions and 6) Job Satisfaction. The SAQ has been adapted for use in ICUs, operating rooms, inpatient wards, ambulatory clinics, emergency departments, maternity wards, and pharmacies. It also exists in a generic version where the care-giving areas are not specified in the items like in "Nurse input is well received in this ICU," but instead is kept neutral like in "Nurse input is well received in this care-giving area." In the short form version that we have used, six items are added to the 30 items belonging to the six factors. The additional items were added because they were considered interesting in their own right by senior leaders participating in the pilot studies (9). The SAQ is the most widely used instrument for measuring patient safety culture. Including our Norwegian translation, the SAQ has now been translated into seven languages, and has been administered in over 2000 hospitals in the USA, United Kingdom, Switzerland, Germany, Norway, Spain, Portugal, Italy, Turkey, Taiwan and New Zealand (spoken communication, Bryan Sexton, Johns Hopkins Quality and Safety Research group, May 2008).

The SAQ is probably the best documented instrument for measuring patient safety culture (9;17). Benchmark scores from 203 clinical areas in the USA, UK and New Zealand have been published with an overall response rate of 67%, ranging from 66% to 72% across administrations. Incomplete data at item level was approximately 1.5% overall, with a range between 0.3 and 3.5%. Multilevel confirmatory factor analysis produced a highly satisfying set of goodness of fit indicators. Composite scale reliability was assessed with Raykov's ρ coefficient, which was 0.90, indicating strong reliability (9). A well-developed patient safety culture, as measured by the SAQ, has been shown to correlate with fewer medication errors,

lower ventilator associated pneumonia rates, fewer blood-stream infections, and shorter ICU lengths of stay (17;21). Although the evidence of this is limited, the SAQ is the only questionnaire with results that link patient safety scores to patient outcome.

To calculate the factor scores one must first reverse the results of negatively worded items. From the mean of the set of items one subtracts 1, and the result is multiplied by 25. The percentage of respondents who “agree slightly” or “agree strongly” for each of the items within a factor is charted as the percent positive for each SAQ factor.

In a meeting with the expert group on patient safety culture under the Nordic minister council, on the 3rd of June 2009, Allan Frankel, who invented Leadership Walk Rounds, shared his experience on the success criteria for doing quantitative patient safety culture surveys. He emphasized that administrative capacity needs to be available to conduct the survey as well as research capacity to analyze and feed back the results.

5. Our Survey

5.1. The Safety Attitudes Questionnaire

We chose to use the Safety Attitudes Questionnaire, generic version (Short form 2006), because we found it to be the best internally and externally validated questionnaire (17). The psychometric properties, documenting internal construct validity, have been published with data from more than 200 sites in the UK, USA and New Zealand, including ICUs, ORs, Inpatient settings and Ambulatory clinics with a response rate of 67 % (9). It has also been tested for test/retest reliability. The SAQ's external validity has been studied by exploring the relationship between safety climate scores and patient outcomes. Although the evidence is limited, favourable scores were associated with shorter lengths of stay, fewer medication errors, lower ventilation associated pneumonia rates and lower blood stream infection rates (17;71;98;99). They were also associated with lower risk adjusted patient mortality rates. Only the SAQ has been used in pre- versus post- intervention studies.

5.2. Translation

Linguistic validation of our translation was performed with the back-translation technique (100). First, one translator did the translation from English to Norwegian and then an independent translator (an American nurse and researcher who has worked for many years in Norway and is fluent in both languages), who was blinded to the original questionnaire, translated it back into the source language. We (ED and DH) compared independently the instrument in its original English version and the version translated back to English, and discussed the re-translation with one of the authors of the American questionnaire. We reformulated a small number of the translated items before we used the Norwegian version of the questionnaire at Akershus University Hospital.

5.3. Setting

The survey was carried out in the somatic clinical areas of Akershus University Hospital from October-December 2006. The hospital has 500 somatic (and 200 psychiatric) beds, 4200 employees, and an annual budget of 2,500,000,000 NOK (approximately 450 million USD). It serves a population of 280,000 people, treats 53,000 in-patients and provides 150,000 out-patient consultations annually. 85% of in-patients are unscheduled emergency admissions. Since we had no examples of the SAQ being used in psychiatric settings we chose to leave these out. We regret that because we later realized it would have been relevant; safety culture in psychiatric facilities is proposed to be related to the incidence of homicides in relation to psychiatric patients (101).

The safety culture survey was part of a patient safety strategy the hospital had adopted, following guidelines developed by the Institute of Healthcare Improvement (80). The heads of the clinical departments were informed about the survey in a meeting and in a letter from the CEO.

5.3.1. Approval by Data Inspectorate and report to Regional Ethics Committee

The study was approved by the Norwegian Data Inspectorate. We also reported the study plan to the regional ethics committee for medical research in Eastern Norway, who decided that it did not need their explicit approval as it did not involve patients.

5.4. Questionnaire administration

Data were collected during regular staff meetings in 47 somatic care-giving units in agreement with unit leaders. Since most physician groups did not have staff meetings but had meetings for reporting and education, we met them in these settings instead. Completing the questionnaire was voluntary. We experienced that staff were enthusiastic and the response rate in the

meetings was high, with the exception of two units. In the first group the leader and some influential individuals were highly critical of the questionnaire, concluding that the survey was meaningless. Before completing the survey they all arose and said they were due to go to a scheduled X-ray meeting.

In the other group we were asked by the contact person, who was not the leader, to not proceed with the survey in their unit. That was after the person had seen the questionnaire and discussed it with other staff. The reason they gave was that the unit was small and dysfunctional and the results would be difficult to handle within the group.

Questionnaires were distributed to 1911 frontline personnel in 14 ambulatory clinics, 27 wards, four labs, one operation unit, and one anaesthetic department. 762 staff received the SAQ in staff meetings and 1149 did so through the hospital's postal system. 1306 staff members completed and returned the questionnaire, with a response rate of 68%.

To alleviate fears of small-group responder identification, we promised that results would not be reported across professions at unit level. Staff not present at the meetings were sent the questionnaire by hospital mail, with a preaddressed envelope and a sheet with information about the survey attached. To keep track of the number of questionnaires administered, questionnaires were numbered individually. The responders' names were not recorded in the questionnaire and there were no name-and-number lists. Those who completed their questionnaire during the meeting were crossed out from the list of employees by the unit leader, who later told us who had not attended the meeting and would have to get their questionnaire by mail. Those who received it by mail crossed out their names on their local unit's list when they returned the questionnaire. To reduce the number of non-responders, a designated person in the care-giving unit was asked to remind persons who hadn't crossed out their name in meetings and by poster. This worked out variably. Although we achieved a reasonable response

rate of 68%, it may have been even better if we had been able to remind those who had not returned the questionnaire, by mail. To do so we would have needed a name-and-number list. In order to ensure that all staff that work in the units and contribute to their culture were included in the survey, we gave the physicians and physiotherapists, who commonly work at more than one care-giving unit, the opportunity to fill out one questionnaire for each of up to three units where they worked; for example the ER, ward and ambulatory clinic. To keep account of the response rate the three questionnaires filled out by physicians and physiotherapists had the same number, but were supplied with an additional a, b, and c. Physicians and physiotherapists were asked to identify which care-giving unit and department their responses referred to; for other responders these boxes were filled out in advance. The information sheet contained a list of the care-giving units participating in the study.

5.5. Data quality and processing

Missing responses at item level was on average 2.9%, within a range of 0 to 13%. This is more than in the benchmarking data but not too bad. Item responses were clearly skewed toward the positive, but showed considerable variation. For all items, all categories were ticked. Questionnaires were scanned by the optical reading program Snap Survey. In cases where different postal responders had used different names for the same care-giving unit (for example, “S5” and “Big children ward”), we harmonized the names into a complete and mutually excluding list of unit names. The confirmatory analysis was done by AMOS. SPSS was used to estimate Cronbach’s alpha, item-to-own correlations, intercorrelations of factors, test-retest correlations and all item-descriptive statistics.

6. Statistical analysis

The first hypothesis we wanted to test was if the published factor structure for benchmarking data from the US, the UK and New Zealand also fitted the Norwegian data adequately. Since the factor structure from benchmarking studies was already published, we tested if our data had the same factor structure by doing a confirmatory factor analysis.

We also wanted to explore at what organizational level the variation was greatest in order to understand at what level patient safety culture should be addressed. We tested our second hypothesis: Patient safety culture scores mapped by the Norwegian questionnaire vary by ward and department, but more across wards than across departments, by doing a multilevel analysis.

Finally, we wanted to explore if leaders and their subordinates have the same perceptions on the extent to which patient safety is important to the organization. The result would reveal if assessments of frontline staffs' perceptions could provide an additional source of information about the safety climate in the care-giving units that supplements filtered information from their leaders. We did this by testing our third hypothesis: Safety climate assessments amongst frontline staff differ from the perceptions of their superiors. The test was done by an independent samples T-test

6.1. Confirmatory factor analysis

Confirmatory factor analysis (CFA) was done to test the first hypothesis, by using AMOS, a computer program that provides formal tests of the goodness of the fit of factor models that are pre-hypothesised for the data. Acceptable goodness of fit-values indicate internal construct validity, meaning that the factor structure of our data fits adequately to the pre-hypothesized factor structure of the benchmarking data. We have reported the following goodness-of-fit indices in our article: the chi square, the chi-square/df-ratio, the p, the p_{close}, the Adjusted

Goodness-of-Fit Index (AGFI), the Root Mean Square Error of Approximation (RMSEA) and the Hoelter 0.05. Suggested criteria values are chi-square, not exceeding the number of degrees of freedom of the model, although Wheaton & Al (102) suggest accepting any chi square/df-ratio under 5, and Carmines and MacIver (103) consider values of 2-3 acceptable, whereas Byrne (104) will not accept ratios above 2. The p and p close values should exceed 0.05 (105), although Jöreskog (106) cautions that large samples may preclude such low p-values even in good models – which is why the Hoelter 0.05 (107), an estimate of the largest sample for which a data set with these intercorrelations among the variables would confirm the model, should exceed 200. The Adjusted Goodness of Fit Index should be close to 1 – but most AGFIs are, and it is not clear which lower values speak against the model. The Root Mean Square Error of Approximation (RSMEA) should not exceed 0.10 (105).

6.2. Psychometric properties

The internal consistency of the factors was also done to test the first hypothesis, by assessing item-total correlations, checking that all items were more highly correlated with the factor they were hypothesised to belong to than with any other factor, and by Cronbach's alpha (consistent factors should have alphas exceeding 0.7), which shows to what extent items within each factor correlate to each other (108).

The test-retest reliability was assessed in the hospital's radiology lab, which with its 97 employees is one of the largest clinical units in the hospital. Its questionnaires were, in addition to the serial number, marked to show if the questionnaire was from the first measurement or the second. The time interval between the two measurements was three weeks. Test-retest stability was assessed by the intraclass correlation coefficient, which should exceed 0.7 (109). We found these to be high for all factors, except for Stress recognition (0.55) and Perceptions of hospital management (0.44). The test-retest correlation

for Perceptions of hospital management was practically zero for non-physicians, but quite high (0.83) for physicians. A possible interpretation is that in the average clinical worker's eyes, the hospital's top management is so distant that it is difficult to maintain a stable perception of its qualities.

6.3. Score calculation

Scores were calculated for each responder for each of the seven patient safety culture factors according to the instruction given by the SAQ-developers http://www.uth.tmc.edu/schools/med/imed/patient_safety/Scale%20Computes.DOC . The factor scores were added to the data file as seven new variables.

6.4. Multilevel analysis

The second hypothesis was tested by analyzing the seven patient safety culture factor scores using MLWin, a multilevel analysis program developed by the University of London's Institute of Education (110). Multilevel analysis makes it possible to partition the variance in the data by level. By applying what is known as "the empty model" – a model which contains only the intercept (the data set's average patient safety attitudes score) and no explanatory variables, we split the total variance in patient safety attitudes scores into variance across individual respondents (individual level variance), across wards (ward level variance) and across departments (department level variance.)

The ratio of the variance at the organizational levels to the total variance in the data is the intraclass correlation coefficient (ICC). Multiplied by 100, the ICC can be interpreted as the percentage of the total variance in the data set that belongs to the organizational level, that is, the percentage of the variance which is not score differences across individual responders, but across the organizational units.

The statistical significance of the variance at organization levels should be judged by the change in the goodness of fit of the model to the data – as measured by the change in the model's log likelihood ratio – produced by eliminating that level from the model. Judging significance by the ratio of the parameter estimate to its standard error works quite well for fixed parameters, that is, parameters estimated under the assumption of having the same value in all subunits of the data set. For random parameters, however, the distribution of this ratio may depart considerably from normality, and a better test for random parameters is to use the likelihood ratio statistic (111). In our case, the "large sample" distribution of the -2LL-value under the null hypothesis (H_0 = the two-level model is adequate) is a χ^2-distribution with k_2-k_1 degrees of freedom – that is: d.f. = 3-2= 1. The critical value for $p < 0.05$ for the change in -2LL is 3.84, and for $p < 0.01$ it is 5.99. As suggested by Pinheiro & Bates (112) this test can be conservative, producing a p-value which is greater than it should be.

6.5. Independent samples T-test

To study the relation between the patient safety perceptions of charge nurses and their subordinate staff, we used data for charge nurses, nurses, midwives, and nurse assistants in the care giving units as well as personnel categorized as "other" (like bioengineers and radiographers in the labs).

For each care giving unit we computed the mean value of the Safety Climate factor score (one of the seven SAQ factors) for charge nurses, nurses, nurse assistants and "other" staff categories. The difference between the score value for every person and the mean score for the unit in which they were working was calculated. To test the third hypothesis we compared the difference between individual value and care giving unit mean value for charge nurses and other staff by independent samples T-test.

7. Findings and summary of papers

7.1. Main findings

We started this thesis by making an overview of patient safety research, which until recently has had its main focus on mechanisms for adverse events and risks related to physical and organizational infrastructure. What the concept of patient safety culture adds to previous research is methods to evaluate if staff perceives that adverse events and risks related to organizational infrastructure are safely addressed. In this perspective, the different research approaches are mutually dependent.

We translated what we considered to be the best internally and externally validated questionnaire for assessing staff perceptions on patient safety culture, the Safety Attitudes Questionnaire (SAQ). The Norwegian translation of the questionnaire was well accepted and gave a response rate of 68%.

Confirmatory factor analysis showed that with small adjustments, the Norwegian data fitted the factor model well. This supports the first hypothesis: 'The published factor structure for Safety Attitudes Questionnaire benchmarking data from the US, the UK and New Zealand also fits the Norwegian data adequately'. The psychometric properties of the translated version were adequate. We also found a correlation between our own data and measurements of patient harm in five departments (the only departments with such data available) which provided preliminary evidence of the questionnaire's predictive validity. Measurements of patient harm were done by medical record review with Global Trigger (50).

Multilevel analysis showed substantial variance at organizational level, most of it at ward level. This supports the second hypothesis: 'Patient safety culture scores mapped by the Norwegian questionnaire vary by ward and department, but more across wards than across departments'. Our recommendation was that to improve patient safety culture in hospitals one cannot exclude efforts directed toward ward level.

Using independent samples T-test we found that charge nurses had significantly more positive perceptions of the safety climate in their area of responsibility than their subordinate staff. The result supports the third hypothesis: 'Perceptions of safety climate amongst employees follow a hierarchical pattern and are more positive the further away from the patients the employees work'. Our result may indicate that information about patient safety culture is filtered as it moves upwards in the hospital hierarchy. The assessment of frontline staff perceptions of patient safety climate is therefore an additional source of information that supplements reports that a manager receives from subordinate leaders. The finding emphasizes the significance of doing patient safety culture surveys.

The following pages summarize the articles on which the thesis is based.

7.2 Roadmap for patient safety research: approaches and road forks – Summary of paper 1

Dag Hofoss, Ellen Deilkås
Published in Scand J Publ Health 2008; 36(8): 812-7

Patient safety improvement and research has become a health care priority worldwide. The purpose of this paper was to give an overview of patient safety research and analyze what knowledge patient safety culture research can add to it. Pioneer research reports include the 1984 Harvard Medical Practice Study, and the 1999 report "To err is human." Patient safety research is expanding rapidly. Among the Scandinavian countries, Denmark is the patient safety improvement leader, and Norway is the laggard, having only recently institutionalized safety research and then having started with industrial safety research, and only recently having expanded into patient safety research.

Patient safety research can be conducted along a number of lines. To identify patient safety problems and come up with ideas for patient safety improvement one can investigate: 1) particular cases of adverse events, 2) the design of health care delivery systems, or 3) the

culture of the care-giving institutions. The study of safety culture can be sub-divided into the study of organization culture in general (and in particular of leadership culture) and the study of patient safety culture. The article provides a number of references to existing instruments of patient safety research.

Scrutinizing adverse events for errors is health care's traditional way of improving patient safety. The idea of re-thinking the design of care delivery systems has been accompanied by claims of modernity. The study of patient safety culture is the most recent approach. Although chronology suggests a developmental trend, the three approaches should not necessarily be seen as steps on evolution's ladder. Each has its merits.

7.3 Psychometric properties of the Norwegian version of the Safety Attitudes Questionnaire (SAQ), Generic version (Short Form 2006) – Summary of paper 2

Ellen T Deilkås and Dag Hofoss
*Published in BMC Health Services Research 2008, **8**:191*

In this paper we present how we translated the Safety Attitudes Questionnaire (SAQ) to Norwegian and validated the psychometric properties of the translated version. The questionnaire was translated with the back translation technique and was tested in 47 clinical units in a Norwegian university hospital. SAQ's (the Generic version (Short Form 2006), the version with the two sets of questions on perceptions of management: on unit management and on hospital management) were distributed to 1911 frontline staff. 762 were distributed during unit meetings and 1149 through the postal system. Questionnaire acceptability was good: 1306 staff members completed and returned the questionnaire: a response rate of 68%. Cronbach's alphas, item-to-own correlations, and test-retest correlations were calculated, and response distribution analysis and confirmatory factor analysis were performed, as well as early validity tests. The reliability measures were acceptable. Cronbach's alphas (0.68 to 0.85) of our seven

factors are described in detail in Appendix 1. For no factor the exclusion of any variable would noticeably increase the Cronbach's alpha value. In the confirmatory factor analysis 36 items were ascribed to seven pre-hypothesized factors: Teamwork Climate, Safety Climate, Stress Recognition, Perceptions of Hospital Management, Perceptions of Unit Management, Working Conditions, and Job Satisfaction. Goodness-of-Fit Indices showed reasonable model fit. Details on these results are found in the article. External validity indicators – recognizability of results, correlations with "trigger tool"-identified adverse events, patient satisfaction with hospitalization, patient reports of possible maltreatment, and patient evaluation of organization of hospital work – provided preliminary validation. Based on the data from Akershus University Hospital, we concluded that the Norwegian translation of the SAQ showed satisfactory internal psychometric properties. With data from one hospital only, we could not draw strong conclusions on its external validity, and further validation studies linking the SAQ-scores to patient outcome data should be performed.

7.4 Patient safety culture: partitioning the variance by organization level ─ Summary of paper 3

Ellen Deilkås, Dag Hofoss
Submitted to BMC Health services research

The aim of this paper was to examine to what degree patient safety culture scores vary not only by individual responder, but also by ward and department. We wanted to determine at what organizational level they varied the most, to learn more about at what organizational level patient safety culture should be addressed. Culture is influenced by what groups learn through collective experiences, especially those that demand leadership. When leaders are forced to prioritize between production demands and safety precautions, they demonstrate their cultural values. Because wards to a greater degree than departments operate at the frontline of healthcare, we expected such learning to happen to a larger degree at ward level than at

department level. We referred to the previous article for a description of the data collection and psychometric validation of the translated version of the Safety Attitudes Questionnaire (SAQ Short Form 2006) which we used to collect the data. We did the multilevel analysis by MLWin version 1.10. Considerable parts of the score variations were at ward and department level. More organization level variation was at ward level than at department level. Our conclusions were: 1) Patient safety culture should be studied as close to the patient as possible. There may be such a thing as "hospital safety culture," and there are differences across hospital departments. But neglecting the study of patient safety culture at ward level will mask important local variations. 2) Patient safety culture improvement efforts should include interventions at ward level, not just department or all-hospital interventions. The results should be used within wards to point out its specific problems with patient safety culture. 3) In recognition of the fact that operational tasks are often solved by microsystems working within wards, we concluded that future patient safety research and improvement efforts should not stop at the level of hospital wards, out-patient clinics, and ERs, but should also collect and analyze patient safety culture data on the microsystems.

7.5. Charge nurses perceive a better safety climate than their subordinate staff – Summary of paper 4

Ellen T Deilkås, Dag Hofoss
Submitted to BMC Health services research

Are perceptions of patient safety climate influenced by the perceiver's position in the organizational hierarchy? Top management declares what priority patient safety should have in the organization's policy, but normally leaves it to frontline leaders to strike the balance between safety policy and other operational requests. Middle-level leaders have to prioritize patient safety in the face of funding restraints and increasing patient needs. Patient safety

climate measurements reflect the extent to which staff perceives that patient safety is important to the organization.

1306 staff in 47 somatic care-giving units filled out the Safety Attitudes Questionnaire, in a 500-bed Norwegian university hospital, from October to December 2006. The mean value of perceptions of safety climate was computed for charge nurses, nurses, nurse assistants and "other" subordinate staff in each care-giving unit.

The mean difference between each individual's perception of safety climate and the mean value for all responders in their own care-giving unit was -0.61 for subordinate staff and + 7.0 for charge nurses. This is a significant difference ($p < 0.001$).

Charge nurses perceived a better safety climate than subordinate staff in the care-giving unit where they were in charge. Our interpretation is that executive leaders would benefit from knowing the perceptions of both, e.g., as mapped by safety culture surveys, instead of having to rely solely on patient safety information filtered through the layers of the organization, which may attenuate the messages given by the front-line care providers.

8. Discussion

Until now we have looked at how a new approach to patient safety has developed in health care management and showed how assessing patient safety culture is a relevant strategy in this approach. We have demonstrated how patient safety culture can be measured by scientific methods from organizational psychology, using our own questionnaire as an example. We have summarized our results on how patient safety culture scores vary according to organizational level and how staff and leaders perceive safety climate differently. We will now recapitulate why we chose to do patient safety culture research and why we chose to use the Safety Attitudes Questionnaire. We will consider how our results have implications for sample size when measuring patient safety culture, and finally discuss how our results are relevant for leaders that want to improve patient safety.

8.1. Deciding to do Patient safety culture research

Some may say that the new approach to patient safety is like old wine in new bottles. They may argue that the concern for patients' safety is age old, and that although adverse events happen to patients, they are often so sick that not treating them would pose a greater risk than doing so. Hospital patients are often vulnerable. Large blood losses or periods of very low blood pressure may increase the risk of having a heart attack. Immobilised patients are prone to venous thrombus embolism. The patient safety approach does not rule out the risks related to patients' health conditions but deals with how well they are addressed when care is planned and delivered. That includes ensuring well functioning technical equipment, good routines for communication and coordination between health workers, and care giving units, and good routines for training staff and organizing their work load. The latter is illustrated by the following story.

A man with torticollis, a neurologic condition which makes his head tip backwards uncontrollably, was scheduled for brain surgery. In the meeting with the neurosurgeon before the operation, the man asked the surgeon how many times he had done this procedure before. The answer was zero. Because he didn't want to be the first, the man cancelled the operation and searched the international community for surgeons with more experience. He found one in Finland who had performed the procedure 50 times. This surgeon later trained Norwegian neurosurgeons in the procedure.

Unfortunately, not all patients are capable of addressing the risks of their own treatment. They should not have to do so either. According to the oath of Hippocrates, this responsibility belongs to the health care worker. It means that health care is obliged to not only consider what treatment is the best for the patient but also be concerned with how safely it is delivered. The patient safety approach is therefore applying an age old concern to the reality of modern healthcare. Since healthcare in recent decades has become increasingly complex in how it is delivered, and is potent in its treatment, the potential for adverse events has increased. The patient safety methodology provides tools to face this and to do something about it. The knowledge about this approach has developed into a new science.

By validating the Norwegian translation of the Safety Attitudes Questionnaire (SAQ), we have chosen the cultural context as our gateway to patient safety research. Alternatively, we could have studied mechanisms for adverse events and tested interventions to reduce them. This could have provided knowledge useful for guiding preventive efforts. Instead, we have decided to study how healthcare workers at the sharp end perceive the priority of patient safety in their working unit, to what extent a blame free environment is encouraged, and to what extent information about organizational mishaps and adverse events is welcomed. Although the evidence that links safety climate to safety behaviour and outcomes for patients is scarce, the fact that it exists (11;12;16;113) gives meaning to pursue further studies. The reason is that if

they prove to be externally valid, safety climate surveys will not only inform leaders about staff perceptions but they may also indicate how safely patients are treated. Our decision to do patient safety culture research is supported by a WHO expert group that ranks patient safety culture as number three on a prioritized list of 50 patient safety research topics in developed countries (5).

As a clinician I am not unbiased to choose this perspective on patient safety. Experiences of junior physicians lacking possibilities to communicate to leadership about how organizational conditions undermine patient safety have motivated me to develop a way to improve this situation. This aim may have influenced the research questions I have posed as to how this questionnaire could be used, and how useful it might be as a tool. My personal motivation may have led me to present the questionnaire with greater enthusiasm in meetings with frontline staff, which again would influence response rate.

However, modern theory of knowledge has dismissed the idea of the neutral scientist that does not influence knowledge development. The scientists' background, professional interests, motives and personal experiences influence the choices of perspectives and methods in the research (114). In qualitative science this is countered by assessing subjectivity, referred to as reflexivity. This means adequately accounting for the effects of the positioned researcher during all steps of the research process. By choosing a quantitative design my bias in this study has to some extent been compensated for. If my hypothesis that safety culture varies to a significant degree at the organizational level was wrong, we would not have been able to reject the null hypothesis. If my hypothesis that staff perceptions vary according to their position in society was wrong, we would not have been able to reject the null hypothesis claiming no coherence between the two. It means that although I am biased in my position the results in the study are strengthened by the validation strategies in the quantitative design (115).

8.2. Choosing the Safety Attitudes Questionnaire

The arguments for choosing to use the Safety Attitudes Questionnaire (SAQ) in this project have already been presented (p70). In addition to it being the best internally and externally validated questionnaire, the SAQ together with the Hospital Survey on Patient Safety (HSOPS), which is also validated in Norwegian (by the University of Stavanger (116)), are considered to be the two questionnaires that best fit the criteria for recommendation, by a preliminary report from the European Network for Patient Safety. The EUNetPas is a project funded and supported by the European Commission. The HSOPS includes the dimension of teamwork across hospital units, which is the research topic that the previously mentioned WHO expert group has ranked as the highest area of prioritization for patient safety research in developing countries (5). In the dimension for perceptions of local management the HSOPS includes questions like: "My supervisor/manager says a good word when he/she sees a job done according to established patient safety procedures" and "Whenever pressure builds up, my supervisor/manager wants us to work faster, even if it means taking shortcuts." The items capture well how safety climate represents the priority of safety in relation to other competing interests (64).

We do not think there are strict arguments for choosing either one instead of the other for patient safety culture assessments because both the SAQ and the HSOPS have unique qualities. The decision to start doing patient safety culture assessment is more important than the choice between these two questionnaires. However, we have concerns regarding the organizational level for doing such measurements and how this has consequences for selecting a sample. Based on the results from testing our second hypothesis and the research evidence (Chapter 3.2.), we believe that the sample for measuring patient safety culture must be large enough to allow the results to be broken down to ward level, where much variation in safety climate scores is found.

8.3. Methodological concerns for measurements of patient safety culture

8.3.1 Considering the appropriate organizational level

Safety climate theory emphasises how safety priorities at local management level reflect both top management's safety priorities and local leaders' capability to enact these in competition with other operational demands (62;65). A weak leadership at top level will facilitate greater climate variations at group level. Although significant clustering of some safety attitude factors was found at department level in our study, our main result is that most of the clustering was at ward level. Where there was significant clustering at department level, variance at ward level was greater. Our interpretation is that departments may differ in how well they are able to support staff efforts to treat patients safely, but that wards vary even more. The results are supported by Pronovost et al. (117) who also found more variability in safety culture measurements between working units than between hospitals and concluded that safety culture is a local phenomena. We therefore believe that the working unit is a relevant organizational level for measuring and improving patient safety culture, as well as for doing further patient safety culture research. We suggest that patient safety culture may also be important for clinical microsystems too. Microsystems are groups of clinicians and staff working together with a shared clinical purpose to provide care for a population of patients (72). They are not visible in formal organizational blueprints, but still exist as contexts of clinical care, often across care-giving units. The safety culture is determined by the whole team that participates in patient care (92) and we therefore believe that perceptions from the whole team probably should be mapped in safety culture assessments. We propose this to be studied further in future research.

8.3.2. Deciding sample size

In deciding the sample size for patient safety culture studies it is important to realize that the sample needs to be large enough to validly measure both strength and level of the climates that the patient safety culture consists of. Climate strength is the deeper level of consensus amongst staff in the responding unit. The consensus will show how well staff in the units agree on the climate mean they have reported (92). Climate level is the mean level of perceptions in the responding unit (118), and shows if the climate is good or bad. With increasing consensus the climate levels will better predict safety outcomes (12).

In the HSOPS guidelines several strategies are presented for selecting samples. One option is to administer surveys to all hospital staff; another option is to administer surveys to subsets of staff from all or some areas. The preferable alternative depends on the level one intends to measure the organizational climate. A small sample is probably adequate to measure organizational climate at hospital level, but not to precisely measure climate strength and climate level in the working units. In order to be able to break the variation in patient safety culture down to unit level, samples must include enough staff in the working units (92). The critical issue is to avoid bias introduced by non responders. To ensure reliable results, a rule of thumb is that the response rate in the sample should be above 60% (117).

When reporting results from the Safety Attitudes Questionnaire the custom is to present the percentage of staff that reports a good safety climate in each responding unit. This is an effective way of showing information on both the climate strength (consensus) and climate level in the working unit (70). An example is how the CUSP intervention at Keystone in Michigan was reported, where teamwork climate in 72 Intensive care units (ICU) was reported to range from 16% to 92% of caregivers reporting good teamwork climate before the intervention (70). 17% of the ICUs had a > = 60% consensus of good teamwork before the

intervention, while 46% had a > = 60% consensus or a 10-point improvement after the intervention.

8.4. Opportunities for leadership to improve patient safety culture

We have previously presented how safety climate is influenced by leadership priorities and have described validated leadership strategies for improving patient safety culture. The question is whether leaders are aware of the need for such strategies. Results presented in the fourth paper support our hypothesis and suggest that leaders tend to perceive a better safety climate than their subordinates. We will discuss how this is relevant for the question of doing patient safety culture surveys.

To what extent do top leaders base their priorities to improve patient safety culture on their perceptions of the safety climate? Although we cannot be sure we find it reasonable to expect that leaders who recognize problems with safety culture are more likely to do something about it. We therefore believe that a mismatch between perceptions of frontline staff and their leaders may be unfortunate for working units where the safety culture is low. Improvement of their safety culture depends on incentives, which their leadership lacks. The following studies demonstrate how a good safety culture depends to a large degree on leadership.

In a two-part Nursing Climate Scale study (12), significant variation in nursing climate was found at both hospital and work unit levels, predicting routine medication safety scores and emergency safety scores. Hospital and unit climates interacted giving the best and the worst results where the climates at the two levels were aligned. A positive climate at work unit level could, however, compensate for a detrimental hospital climate: leaders at work unit level can make a difference in a healthcare system that in itself gives little priority to patient safety. In

the Nursing Climate Scale study (12), the best safety scores were found in hospitals where both leadership at hospital level and unit level gave patient safety high priority.

In a study performed on 401 working groups in 36 small to medium manufacturing plants, the relationship between safety climate at organizational level and work unit level and safety behavior at work unit level was explored (62). Safety behavior was observed by using a standardized checklist of nine safety behavior categories (e.g., use of protective equipment, machine handling, materials handling) adapted from the European Commission's 2005 safety audit guide. Independent safety audits were also conducted by an independent senior safety inspector using the same checklist. Safety climate was correlated between organizational and group levels. The effect of safety climate at organizational level on employees' safety behavior was fully mediated by safety climate at group level (62).

In our study we found that frontline staff had relatively low perceptions of hospital management's priority to patient safety compared to perceptions of teamwork climate, safety climate and job satisfaction. Our interpretation is that a clinical culture of patient safety may ─ and often does ─ precede management commitment to patient safety. This suggests that we maybe would have found an even better culture of patient safety if perceptions of management commitment to patient safety had been perceived to be higher. On the other hand, frontline staff's low perceptions of hospital management's patient safety commitment may also reflect little interaction with management, as well as a lack of knowledge on how committed management really is. It may also reflect a lack of initiative related to patient safety issues, because management perceives a better safety climate than their subordinates.

The significance of leadership is consistent with experiences the Institute of Healthcare Improvement (IHI) did in the 100K lives campaign and with recent research (79;119), showing that hospitals that excelled in patient safety results also had favorable organizational

environments. The patient safety results were measured by clinical quality and risk adjusted mortality scores in hospitals. They depended on how much time boards spend on quality issues at board meetings, if they had a particular board quality committee and how it was composed, if quality performance reports were used and if senior executives compensation was linked to quality improvement and if medical staff was involved in the quality strategy (20;120). The IHI concluded that hospital boards lack priority for quality and safety improvement, and have made it a focal point, in their last campaign, to get "the boards on board."

Although the priorities for quality and safety in healthcare have not been changed much by Total Quality Management (121), recognition of the significance of hospital board routines may perhaps lead to a change. But governance priorities are not enough to ensure a good safety climate at work unit level. That also depends on the priorities of leaders at lower levels. Hospital boards may provide the recognition that subordinate leaders need to be able to compensate for lacking support for safety from executive leaders. By using a balanced set of performance metrics, board members may ensure that patient safety is enacted and not marginalized by production demands.

One example of a balanced set of system-level measures, which enables board members and other health care leaders to evaluate their health care systems, is the Whole System Measures (122). It is made to reflect the six important quality dimensions of patient care: safe, effective, patient centred, timely, efficient, and equitable, and consists of 13 measures (51). The measures include: 1) rate of adverse events (measured by medical chart review, for example, with Global trigger tool); 2) incidence of nonfatal occupational injuries and illnesses; 3) Hospital standard mortality ratio; 4) Unadjusted Raw mortality percentage, 5) Functional health outcomes score; 6) Hospital readmission percentage; 7) Reliability of core measures; 8) Patient Satisfaction with care score; 9) Patient experience Score; 10) Days to third next available

appointment; 11) Hospital days per decedent during the last six months of Life; 12) Health care costs per capita; and 13) Equity.

In our study we found that charge nurses perceived a better safety climate than their subordinate staff. This is supported by another study that found senior managers to perceive a better safety climate than their subordinate leaders and frontline workers (123). Both studies show that perception of safety climate depends on the responder's position in the hierarchy. The causes may be:

First, the further away from the front line employees are placed, the less they are exposed to patient safety hazards. A position higher in the hierarchy will easily give an emotional distance to patients that experience unsafe incidents, and will reduce its influence on how they perceive the safety climate.

Second, the further away a leader is from the front line, the more the information on patient safety, which gets through to the leader, will be filtered. That is related to the number of times the information is handed over from person to person.

Third, employees in an organization with a bad safety climate may feel discomfort in reporting about near misses and adverse events for a number of reasons, including that they may believe that this information is not desired by management. In such a climate leaders may not hear much about problems that undermine patient safety.

It is plausible to think that leaders who perceive a better safety climate than their subordinates need more exposure to the consequences of safety hazards. Such experiences have the potential to break down emotional distance and give them unfiltered information about how patient safety is addressed in their organization. This approach seems to be the basis of the Leadership Walk Rounds strategy, which emphasizes the importance of facilitating a dialogue between executive leaders, subordinate leaders and caregivers at the frontline. By hearing patients that

have experienced harm tell their story and by learning how routines and infrastructure in their organization influences the context of patient care, a better understanding of their influence on patient safety may develop. Some concerns of frontline workers may also demand solutions that need to be found at higher organizational levels, especially if they demand coordination with other units and departments. Such concerns will perhaps be more easily surfaced to executive leaders in direct contact than if it had to be passed on through several levels of leaders. Meeting with care giving units, listening to their concerns, and dealing with the concerns afterwards also gives executive leaders an opportunity to demonstrate their true priority of patient safety.

In studying the interaction between supervisors and subordinates, Zohar found that it increased significantly in groups where the supervisors were given feedback based on standardized interviews with the subordinates (54). In the intervention, which resulted in significant improvement in the workers' safety behavior and safety climate scores, subordinates gave information about how their supervisors communicated the priority of safety over competing goals like speed or schedules. The study shows the significance of the interaction between leadership and frontline workers to maintain a good safety climate.

How this can be done in healthcare is demonstrated in the previously described models of CUSP, and Leadership Walk Rounds. Both facilitate cooperation between frontline workers, their unit leader and an executive leader to improve patient safety culture. After the intervention of the previously mentioned (p.55) Leadership Walk Rounds, staff perceptions on safety climate improved for all staff categories, except for charge nurses (77). Charge nurses' perceptions became worse after the intervention, approaching the level of nurses and staff physicians. One reason may be that the intervention which facilitates a dialogue with subordinate staff and physicians, gave the charge nurses a more realistic picture of how well patient safety was supported in their unit.

The fact that leaders perceive a better safety climate than their subordinates should probably be considered when decisions are made on whether to do patient safety culture surveys or not. Because good safety cultures depend on leadership support, their access to unfiltered information about the safety of patient care is crucial. Survey data from patient safety culture assessments may be used in preparation for and evaluation of Leadership Walk Rounds and CUSP, using the results within wards to point out its specific problems with patient safety culture (15;117). It is important to avoid stigmatizing low-scoring units as "low-scorers." Also, low-performing wards are not the only providers of useful information. Results from high-scoring units are equally interesting and may suggest solutions to specific problems with patient safety culture.

Although Pronovost and Sexton have shown that variation of safety culture is considerably greater at work unit level than at hospital level (117), best results are achieved where patient safety is given priority by both executive leadership and leaders at work unit level (12). This gives meaning to further exploration of how patient safety priority at executive level can be increased.

9. Conclusion

In our review of patient safety research we have identified the following approaches, to study 1) particular cases of adverse events, 2) the design of health care delivery systems, or 3) the culture of the care-giving institutions. Although patient safety culture research is the most recent approach, we believe that they are equally important for improving patient safety.

The Norwegian translation of the Safety Attitudes Questionnaire produced data that fitted the factor structure of published benchmarking data. Our first hypothesis was hence supported, and we could go further on applying the questionnaire to test our two other main hypotheses.

A significant part of the variation of patient safety scores was found at ward level. This strengthens our second hypothesis and implies that surveys of patient safety culture should include enough staff to be able to break the results down to ward level (Chapters 3.2. and 8.3.1.).

We finally found that charge nurses perceive a better safety climate than their subordinates which supports our third hypothesis. The result suggests that patient safety information is increasingly filtered the higher up it is reported in the organization. Safety culture surveys provide access to unfiltered information about how staff perceive that patient safety is supported where they work. The information may be useful when healthcare leaders plan interventions for patient safety improvement.

Reference List

(1) Brennan TA, Leape LL, Laird NM, Hebert L, Localio AR, Lawthers AG, et al. Incidence of adverse events and negligence in hospitalized patients. Results of the Harvard Medical Practice Study I. N Engl J Med 1991 Feb 7;324(6):370-6.

(2) Kohn LT, Corrigan JM, Donaldson MS, (Eds). To Err is Human. Building a Safer Health System. Washington DC: National Academy Press; 1999.

(3) Donaldson L. An organisation with a memory. UK: The Stationary Office Limited; 2000. Report No.: 1.

(4) The Research Priority Setting Working Group of the World Alliance for Patient Safety. Summary of the Evidence on Patient Safety: Implications for Research. Geneva, Switzerland: WHO Press, World Health Organization, 2008.

(5) Bates DW, Larizgoitia I, Prasopa-Plaizier N, Jha AK, on behalf of the Research Priority Setting Working Group of the WHO World Alliance for Patient Safety. Global priorities for patient safety research. BMJ 2009 May 23;338:1242-4.

(6) Guldenmund FW. The nature of safety culture: a review of theory and research. Saf Sci 2000 Feb;34:215-57.

(7) Flin R. Measuring safety culture in healthcare: A case for accurate diagnosis. Saf Sci 2007 Jul;45(6):653-67.

(8) Dov Z. Safety climate and beyond: A multi-level multi-climate framework. Saf Sci 2008 Mar;46(3):376-87.

(9) Sexton J, Helmreich R, Neilands T, Rowan K, Vella K, Boyden J, et al. The Safety Attitudes Questionnaire: psychometric properties, benchmarking data, and emerging research. BMC Health Serv Res 2006;6(1):44.

(10) Sexton JB, Thomas EJ, Helmreich RL. Error, stress, and teamwork in medicine and aviation: cross sectional surveys. BMJ 2000;320:745-9.

(11) Hofmann D, Mark B. An investigation of the relationship between safety climate and medication errors as well as other nurse and patient outcomes . Personnel Psychology 2006;59(4):847-69.

(12) Zohar D, Livne Y, Orly T, Admi H, Donchin Y. Healthcare climate: A framework for measuring and improving patient safety. Critical Care Medicine 2007 May;35(5):1312-7.

(13) Kirk S, Parker D, Claridge T, Esmail A, Marshall M. Patient safety culture in primary care: developing a theoretical framework for practical use. Qual Saf Health Care 2007 Aug 1;16(4):313-20.

(14) Bodur S, Filiz E. A survey on patient safety culture in primary healthcare services in Turkey. Int J Qual Health Care 2009 Oct 1;21(5):348-55.

(15) Frankel A, Grillo SP, Pittman M, Thomas EJ, Horowitz L, Page M, et al. Revealing and Resolving Patient Safety Defects: The Impact of Leadership WalkRounds on Frontline Caregiver Assessments of Patient Safety . Health Serv Res 2009;43(6):2050-66.

(16) Pronovost PJ, Berenholtz SM, Goeschel C, Thom I, Watson SR, Holzmueller CG, et al. Improving patient safety in intensive care units in Michigan. Journal of Critical Care 2008 Jun;23(2):207-21.

(17) Colla JB, Bracken AC, Kinney LM, Weeks WB. Measuring patient safety climate: a review of surveys. Qual Saf Health Care 2005;14:364-6.

(18) Sir Liam Donaldson. World alliance for Patient Safety. WHO, France: WHO; 2005.

(19) Cook RI, Render M, Woods DD. Gaps in the continuity of care and progress on patient safety. BMJ 2000 Mar 18;320(7237):791-4.

(20) Jiang HJ, Lockee C, Bass K, Fraser I. Board oversight of Quality: Any Differences in Prcess of Care and Mortality. Journal of Healthcare Management 2009 Jan;54(1):15-30.

(21) Pronovost PJ, Berenholtz SM, Goeschel CA, Needham DM, Sexton JB, Thompson DA, et al. Creating High Reliability in Health Care Organizations. Health Serv Res 2006 Aug;41:1599-617.

(22) Kenney C. The best practice - How the New Quality Movement Is Transforming Medicine. New York: PublicAffairs; 2008.

(23) (Eds). Gjennombruddsprosjekter. Homepage, The Norwegian Medical Association 2009Available from: URL: http://www.legeforeningen.no/id/79985

(24) Wachter RM, Pronovost PJ. The 100,000 Lives Campaign: A Scientific and Policy Review. Joint Commission Journal on Quality and Patient Safety 2006 Nov; 32 (11):621-7.

(25) Berwick DM, Hackbarth AD, McCannon CJ. IHI Replies to "The 100 000 Lives Campaign: A Scientific and Policy Review". Joint Commission Journal on Quality and Patient Safety 2006;32(11):628-33.

(26) Learning from Bristol: the report of the public inquiry into children's heart surgery at the Bristol Royal Infirmary 1984 -1995. the Bristol Royal Infirmary Inquiry; 2001 Jul.

(27) Vincent C. *Patient Safety. London* : *Elsevier 2006*; 2006.

(28) Australian Patient Safety Foundation - History and Objectives. Australian Patient Safety Foundation 2009 August 9Available from: URL: http://www.apsf.net.au/history.php

(29) Canadian Patient Safety Institute. Canadian Patient Safety Institute 2009Available from: URL: http://www.patientsafetyinstitute.ca/English/Pages/default.aspx

(30) Scottish Patient Safety Alliance . Scottish Patient Safety Alliance 2009Available from: URL: http://www.patientsafetyalliance.scot.nhs.uk/

(31) Poulsen J. Dansk Selskab for Patientsikkerhed. Ugeskr Læger 2002;164(17):2253.

(32) Dansk Selskab for Patientsikkerhed. Dansk Selskab for Patientsikkerhed 2009Available from: URL: http://www.patientsikkerhed.dk/

(33) Haynes AB, Weiser TG, Berry WR, Lipsitz SR, Breizat AH, Dellinger EP, et al. A Surgical Safety Checklist to Reduce Morbidity and Mortality in a Global Population. N Engl J Med 2009 Jan 29;360(5):491-9.

(34) Apkon M, Leonard J, Probst L, DeLizio L, Vitale R. Design of a safer approach to intravenous drug infusions: failure mode effects analysis. Qual Saf Health Care 2004 Aug 1;13(4):265-71.

(35) Marx DA, Slonim AD. Assessing patient safety risk before the injury occurs: an introduction to sociotechnical probabilistic risk modelling in health care. Qual Saf Health Care 2003 Dec 1;12(90002):33ii-38.

(36) Wreathall J, Nemeth C. Assessing risk: the role of probabilistic risk assessment (PRA) in patient safety improvement. Qual Saf Health Care 2004 Jun 1;13(3):206-12.

(37) Reason J. Human error: models and management. BMJ 2000 Mar 18;320(7237):768-70.

(38) Bagian JP, Gosbee J, Lee CZ, Williams L, McKnight SD, Mannos DM. The Veterans Affairs Root Cause analysis System in Action. Jt Comm J Qual Improv 2002;28(10):531-45.

(39) Sari AB-A, Sheldon TA, Cracknell A, Turnbull A. Sensitivity of routine system for reporting patient safety incidents in an NHS hospital: retrospective patient case note review. BMJ 2007 Jan 13;334(7584):79.

(40) Vincent C. Incident reporting and patient safety. BMJ 2007 Jan 13;334(7584):51.

(41) Surbone A, Rowe M, Gallagher TH. Confronting Medical Errors in Oncology and Disclosing Them to Cancer Patients. J Clin Oncol 2007 Apr 20;25(12):1463-7.

(42) Billings C. Incident reporting systems in medicine and experience with the aviation reporting system. In: In Cook RI WDMCe, editor. A tale of two stories: contrasting views of patient safety. North Adams, MA: US National Patient Safety Foundation; 1998. p. 52-61.

(43) Resar RK, Rozich JD, Classen D. Methodology and rationale for the measurement of harm with trigger tools. Qual Saf Health Care 2003 Dec 1;12(90002):39ii-45.

(44) Wilson RM, Runciman WB, Gibberd RW, Harrison BT, Newby L, Hamilton JD. The Quality in Australian Health Care Study. Med J Aust 1995 Nov 6;163(9):458-71.

(45) Wilson RM, Harrison BT, Gibberd RW, Hamilton JD. An analysis of the causes of adverse events from the Quality in Australian Health Care Study. Medical Journal of Australia 1999;170(9):411-5.

(46) Vincent C, Neale G, Woloshynowych M. Adverse events in British hospitals: preliminary retrospective record review. BMJ 2001 Mar 3;322(7285):517-9.

(47) Baker GR, Norton PG, Flintoft V, Blais R, Brown A, Cox J, et al. The Canadian Adverse Events Study: the incidence of adverse events among hospital patients in Canada. CMAJ 2004 May 25;170(11):1678-86.

(48) Schioler T, Lipczak H, Pedersen BL, Mogensen TS, Bech KB, Stockmarr A, et al. [Incidence of adverse events in hospitals. A retrospective study of medical records]. Ugeskr Laeger 2001 Sep 24;163(39):5370-8.

(49) Leape LL, Brennan TA, Laird N, Lawthers AG, Localio AR, Barnes BA, et al. The nature of adverse events in hospitalized patients. Results of the Harvard Medical Practice Study II. N Engl J Med 1991 Feb 7;324(6):377-84.

(50) Griffin FA, Resar R. IHI Global Trigger Tool for Measuring Adverse Events (Second Edition). Cambridge, Massachusetts: Institute for Healthcare Improvement; 2009.

(51) Institute of Medicine CoQoHCiA. Crossing the Quality Chasm. A New Health System for the 21st Century. Washington, DC: National Academies Press; 2001.

(52) Nieva VF, Sorra J. Safety culture assessment: a tool for improving patient safety in healthcare organizations. Qual Saf Health Care 2003;12(Suppl 2:ii):17-23.

(53) Zohar D. A group-level model of safety climate: Testing the effect of group climate on microaccidents in manufacturing jobs. Journal of Applied Psychology 2000 Aug;85(4):587-96.

(54) Zohar D, Luria G. The use of supervisory practices as leverage to improve safety behavior: A cross-level intervention model. Journal of Safety Research 2003;34(5):567-77.

(55) Sexton JB, Paine L, Manfuso J, Holzmueller CG, Martinez E, Moore D, et al. A Check-up for Safety Culture in "My Patient Care Area". The Joint Commission Journal on Quality and Patient Safety 2007 Nov;33(11):699-703.

(56) Hofstede G. Cultural dimensions in management and planning. Asia Pacific Journal of Management 1984 Jan 1;1(2):81-99.

(57) Morgan G. Creating Social reality - Organizations as Cultures. In: Morgan G, editor. Images of Organization.Beverly Hills: Sage Publications; 1986. p. 111-40.

(58) Helmreich RL, Merritt AC. Culture at Work in Aviation and Medicine. Burlington: Ashgate; 1998.

(59) Schein E. Organizational Culture. American Psychologist 1990 Feb;45(2):109-19.

(60) Lawrence J, Demaree R, Wolf G. Estimating within-group interrater reliability with and without response bias. Journal of Applied Psychology 1984 Feb;69(1):85-98.

(61) Mark B, Hughes L, Belye M, Chang Y, Hofmann D, Jones C, et al. Does safety climate moderate the influence of staffing adequacy and work conditions on nurse injuries? J Safety Res 2007 Nov 5;38(4):431-46.

(62) Zohar D, Luria G. A multilevel model of safety climate: cross-level relationships between organization and group-level climates. J Appl Psychol 2005 Jul;90(4):616-28.

(63) Zohar D. Modifying Supervisory Practices to Improve Subunit Safety: A Leadership-Based Intervention Model. Journal of Applied Psychology 2002;87(1):156-63.

(64) Zohar D. The Influence of Leadership and Climate on occupational Health and Safety. In: Hofmann D, Tetrick L, editors. Health and Safety in Organizations: A Multilevel Perspective. Pfeiffer; 2003. p. 201-27.

(65) Zohar D. The effects of leadership dimensions, safety climate, and assigned priorities on minor injuries in work groups. Journal of organizational behavior 2002 Feb;23(1):75-92.

(66) Deilkas E, Hofoss D. Psychometric properties of the Norwegian version of the Safety Attitudes Questionnaire (SAQ), Generic version (Short Form 2006). BMC Health Serv Res 2008;8(1):191.

(67) Walton MM. Hierarchies: the Berlin Wall of patient safety. Qual Saf Health Care 2006 Aug 1;15(4):229-30.

(68) Edmondson AC. Speaking Up in the Operating Room: How Team Leaders Promote Learning in Interdisciplinary Action Teams. J Manage Stud 2003 Sep;40(6):1419-52(34).

(69) Mannion R, Davies HTO, Marshall MM. Cultures for performance in health care. Maidenhead UK: Open University Press; 2005.

(70) Pronovost PJ, Berenholtz SM, Goeschel C, Thom I, Watson SR, Holzmueller CG, et al. Improving patient safety in intensive care units in Michigan. Journal of Critical Care 2008 Jun;23(2):207-21.

(71) Pronovost P, et al. An Intervention to Decrease Catheter-Related Bloodstream Infections in the ICU. N Engl J Med 2006 Dec 28;355(26):2725-32.

(72) Mohr J, Batalden P, Barach P. Integrating patient safety into the clinical microsystem. Qual Saf Health Care 2004 Dec 1;13(suppl_2):ii34-ii38.

(73) McKinley KE, Berry SA, Laam LA, Doll MC, Brin KP, Bothe A, et al. Clinical Microsystems, Part 4. Building Innovative Population-Specific Mesosystems. Joint Commission Journal on Quality and Patient Safety 2008 Nov;34:655-63.

(74) Thomas EJ, Sexton JB, Helmreich RL. Discrepant attitudes about teamwork among critical care nurses and physicians. Crit Care Med 2003;31(3):956-9.

(75) Makary MA, Sexton JB, Freischlag JA, Holzmueller CG, Millman EA, Rowen L, et al. Operating Room Teamwork among Physicians and Nurses: Teamwork in the Eye of the Beholder. Journal of the American College of Surgeons 2006 May;202(5):746-52.

(76) Thomas EJ, Sexton JB, Neilands TB, Frankel A, Helmreich RL. The effect of executive walk rounds on nurse safety climate attitudes. A randomized trial of clinical units BMC Health Services Research 2005;5:28.

(77) Frankel A, Grillo S, Pittman M, Thomas E, Horowitz L, Page M, et al. Revealing and Resolving Patient Safety Defects: The Impact of Leadership WalkRounds on Frontline Caregiver Assessments of Patient Safety. Health Serv Res 2008 Jul 30;43(6):2050-66.

(78) Pronovost P, Morlock L, Dorman T. Creating and Maintaining Safe Systems of ICU Care. In: Vincent JL, editor. Yearbook of intensive care and emergency medicine.Berlin: Springer Verlag; 2001. p. 695-708.

(79) Conway J. Getting Boards on Board: Engaging Governing Boards in Quality and Safety. The Joint Commision Journal on Quality and Patient Safety 2008 Apr;34(4):214-20.

(80) Botwinick L, Bisognano M, Haraden C. Leadership Guide to Patient Safety. Cambridge , Massachusetts: Institute for Healthcare Improvement; 2006.

(81) McDonald R, Waring J, Harrison S, Walshe K, Boaden R. Rules and guidelines in clinical practice: a qualitative study in operating theatres of doctors' and nurses' views. Qual Saf Health Care 2005 Aug 1;14(4):290-4.

(82) Manchester Patient Safety Framework (MaPSaF). National Patient Safety Agency 2008 July 25 [cited 2008 Jul 25];Available from: URL: http://www.npsa.nhs.uk/patientsafety/improvingpatientsafety/humanfactors/mapsaf/

(83) Mannion R, Konteh FH, Davies HTO. Assessing organisational culture for quality and safety improvement: a national survey of tools and tool use. Qual Saf Health Care 2009 Apr 1;18(2):153-6.

(84) Carthey J, de Leval MR, Reason JT. Institutional resilience in healthcare systems. Qual Saf Health Care 2001 Mar 1;10(1):29-32.

(85) Sorra JS, Nieva VF. Hospital Survey on Patient Safety Culture. (Prepared by Westat, under Contract No. 290-96-0004). AHRQ Publication. Rockville, MD: Agency for Healthcare Research and Quality; 2004. Report No.: 0041.

(86) Burr M, Sorra J, Nieva VF. Analysis of the Veterans Administration (VA) National Center for Patient Safety (NCPS) FY 2000 Patient Safety Questionnaire. Technical report. AHRQ; 2002.

(87) Weingart SN, Farbstein K, Davis RB, Phillips RS. Using a multihospital survey to examine the safety culture. Joint Commission Journal on Quality and Safety 2004;30:125-32.

(88) Sexton JB, Thomas EJ, Helmreich RL, Neilands TB, Rowan K, Vella K, et al. Frontline Assessments of Healthcare Culture: Safety Attitudes Questionnaire Norms and Psychometric properties. Technical report 04-01. 2004.

(89) Flin R, Burns C, Mearns K, Yule S, Robertson EM. Measuring safety climate in health care. Qual Saf Health Care 2006 Apr 1;15(2):109-15.

(90) Smits M, Christiaans-Dingelhoff I, Wagner C, Wal G, Groenewegen P. The psychometric properties of the 'Hospital Survey on Patient Safety Culture' in Dutch hospitals. BMC Health Serv Res 2008;8(1):230.

(91) Singer SJ, Gaba DM, Geppert JJ, Sinaiko AD, Howard SK, Park KC. The culture of safety: results of an organization-wide survey in 15 California hospitals. Qual Saf Health Care 2003 Apr 1;12(2):112-8.

(92) Zohar D. Safety Climate: Conceptual and Measurement Issues. In: James Campbell Quick, Lois Tetrick, editors. Handbook of Occupational Health Psychology.Washington,D.C.: American Psychological Association; 2003. p. 123-42.

(93) Helmreich RL, Merritt AC, Sherman PJ, Gregorich SE, Wiener EL. The Flight Management Attitudes Questionnaire. Technical Report. Austin, TX: The University of Texas; 1993. Report No.: 93-4.

(94) Vincent C, Taylor-Adams S, Stanhope N. Framework for analysing risk and safety in clinical medicine. BMJ 1998 Apr 11;316(7138):1154-7.

(95) Donabedian A. The Quality of Care: How Can It Be Assessed? JAMA 1988 Sep 23;260(12):1743-8.

(96) Resar RK. Making Noncatastrophic Health Care Processes Reliable: Learning to Walk before Running in Creating High-Reliability Organizations. Health Serv Res 2006 Aug;41:1677-89.

(97) Ohno T. Toyota Production System - Beyond Large-Scale Production. New York: Productivity, Inc.; 1988.

(98) Pronovost P, Weast B, Rosenstein BJ, Sexton B, Holzmueller CG, Paine L, et al. Implementing and validating a comprehensive unit-based safety program. J Patient Saf 2005;1:33-40.

(99) Sexton JB. A Matter of life or death: Social psychological and organizational factors related to patient outcomes in the intensive care unit. Unpublished doctoral dissertation 2002.

(100) Sperber AD. Translation and validation of study instruments for cross-cultural research. Gastroenterology 2004 Jan;126(Supplement 1):S124-S128.

(101) Tidmarsh D. Psychiatric risk, safety cultures and homicide inquiries. Journal of Forensic Psychiatry & Psychology 1997;8(1):138-51.

(102) Wheaton B, Muthén B, Alwin DF, Summers GF. Assessing reliability and stability in panel models. In: In Heise DRT, editor. Sociological Methodology.San Francisco: Jossey-Bass; 1977.

(103) Carmines EG, McIver JP. Analyzing models with unobserved variables. In: Borhnstedt GW, Borgatta EF, editors. Social measurement: current issues.Beverly Hills: Sage; 1981.

(104) Byrne BM. A primer of LISREL. Basic applications and programming for confirmatory factor analysis models. New York: Springer-Verlag; 1989.

(105) Browne M, Cudeck R. Alternative ways of assessing model fit. In: Bollen KA, Long JS, editors. Testing structural equation models.Newbury Park, California: Sage; 1993. p. 136-62.

(106) Jöreskog K. A general approach to confirmatory maximum likelihood factor analysis. Psykometrika 1969;34:183-202.

(107) Hoelter JW. The analysis of covariance structures: goodness-of-fit indices. Sociological Methods and Research 1983;11:325-44.

(108) Nunnally J, Bernstein I. *Psychometric Theory* . 3rd ed. New York: McGraw Hill; 1994.

(109) Garratt AM, Bjertnaes OA, Barlinn J. Parent experiences of paediatric care (PEPC) questionnaire: reliability and validity following a national survey. Acta Paediatrica 2007 Feb 3;96(2):246-52.

(110) Rasbash J, Steele F, Browne W, Prosser B. A user's guide to MLwiN version 2.0. London: Institute of Education; 2004.

(111) Woodhouse G. Multilevel modelling applications. A guide for users of MLn.London: University of London, Institute of Education; 1996. p. 32.

(112) Pinheiro J, Bates D. Mixed-effects models in S and S+.New York: Springer; 2004. p. 83-4.

(113) Pronovost PM, Weast BM, Rosenstein BM, Sexton JBP, Holzmueller CGB, Paine LM, et al. Implementing and Validating a Comprehensive Unit-Based Safety Program. Journal of Patient Safety 2005 Mar;1(1):33-40.

(114) Malterud K. Qualitative research: standards, challenges, and guidelines. The Lancet 2001 Aug 11;358(9280):483-8.

(115) Hellevik O. Forskningsmetode i sosiologi og statsvitenskap. Oslo: Universitetsforlaget; 2002.

(116) Sorra JS, Nieva VF. Hospital Survey on Patient Safety Culture. (Prepared by Westat, under Contract No. 290-96-0004). AHRQ Publication. Rockville, MD: Agency for Healthcare Research and Quality; 2004. Report No.: 0041.

(117) Pronovost P, Sexton B. Assessing safety culture: guidelines and recommendations. Qual Saf Health Care 2005 Aug 1;14(4):231-3.

(118) Scale computation instructions. 28-8-2008. http://www.uth.tmc.edu/schools/med/imed/patient_safety/Scale%20Computes.DOC. Ref Type: Online Source

(119) Vaughn T, Koepke M, Kroch E, Lehrman W, Sinha S, Levey S. Engagement of Leadership in Quality Improvement Initiatives: Executive Quality Improvement Survey Results. Journal of Patient Safety 2006;2(1).

(120) Kroch E, Vaughn T, Koepke M, Roman S, Foster D, Sinha S, et al. Hospital Boards and Quality Dashboards. J Patient Saf 2006;2:10-9.

(121) Øvretveit J. Total quality management in European healthcare. International Journal of Health Care Quality Assurance 2000;13(2):74-80.

(122) Martin L, Nelson EC, Lloyd RC, Nolan T. Whole System Measures. Cambridge, Massachusetts: Institute for Healthcare Improvement; 2007.

(123) Singer SJ, Falwell A, Gaba DM, Baker LC. Patient Safety Climate in US Hospitals: Variation by Management Level. Medical Care 2008;46(11):-1149.

Paper II

BMC Health Services Research

BioMed Central

Research article

Open Access

Psychometric properties of the Norwegian version of the Safety Attitudes Questionnaire (SAQ), Generic version (Short Form 2006)

Ellen T Deilkås* and Dag Hofoss

Address: Health Services Research Unit, Akershus University Hospital, Lorenskog, Norway

Email: Ellen T Deilkås* - ellen.deilkaas@ahus.no; Dag Hofoss - dag.hofoss@ahus.no

* Corresponding author

Published: 22 September 2008

BMC Health Services Research 2008, **8**:191 doi:10.1186/1472-6963-8-191

Received: 12 March 2008

Accepted: 22 September 2008

This article is available from: http://www.biomedcentral.com/1472-6963/8/191

Abstract

Background: How to protect patients from harm is a question of universal interest. Measuring and improving safety culture in care giving units is an important strategy for promoting a safe environment for patients. The Safety Attitudes Questionnaire (SAQ) is the only instrument that measures safety culture in a way which correlates with patient outcome. We have translated the SAQ to Norwegian and validated the translated version. The psychometric properties of the translated questionnaire are presented in this article.

Methods: The questionnaire was translated with the back translation technique and tested in 47 clinical units in a Norwegian university hospital. SAQ's (the Generic version (Short Form 2006) the version with the two sets of questions on perceptions of management: on unit management and on hospital management) were distributed to 1911 frontline staff. 762 were distributed during unit meetings and 1149 through the postal system. Cronbach alphas, item-to-own correlations, and test-retest correlations were calculated, and response distribution analysis and confirmatory factor analysis were performed, as well as early validity tests.

Results: 1306 staff members completed and returned the questionnaire: a response rate of 68%. Questionnaire acceptability was good. The reliability measures were acceptable. The factor structure of the responses was tested by confirmatory factor analysis. 36 items were ascribed to seven underlying factors: Teamwork Climate, Safety Climate, Stress Recognition, Perceptions of Hospital Management, Perceptions of Unit Management, Working conditions, and Job satisfaction. Goodness-of-Fit Indices showed reasonable, but not indisputable, model fit. External validity indicators – recognizability of results, correlations with "trigger tool"-identified adverse events, with patient satisfaction with hospitalization, patient reports of possible maltreatment, and patient evaluation of organization of hospital work – provided preliminary validation.

Conclusion: Based on the data from Akershus University Hospital, we conclude that the Norwegian translation of the SAQ showed satisfactory internal psychometric properties. With data from one hospital only, we cannot draw strong conclusions on its external validity. Further validation studies linking the SAQ-scores to patient outcome data should be performed.

Background

How to create a culture that supports patient safety is a question of considerable interest. Increasing efforts have been made to develop ways of measuring safety culture in clinical areas. Staff perceptions on workplace support for keeping patients safe emerges as an important measure. Safety culture surveys summarise staff perceptions on teamwork climate, safety climate, managerial support, self assurance, staffing and work environment factors. Results may be used to identify and help care-giving units that have problems with patient safety [1].

Implementing the comprehensive unit based safety program (CUSP) has been demonstrated to improve safety culture and reduce harm to patients [2]. CUSP consists of 8 steps; assessment of safety culture; sciences of safety education; staff identification of safety concerns; senior executives adopt a unit; improvements implemented from safety concerns; efforts documented and analyzed; results shared; and culture reassessed.

Patient safety culture can be studied quantitatively by surveys or qualitatively by anthropological/ethnographic methods – with a "middle category" consisting of questionnaires constructed to function as guidelines for reflective dialogue in staff groups, like the "Strategies for Leadership: an Organizational Approach to Patient Safety" (SLOAPS) [3], the "Checklist for Assessing Institutional Resilience" (CAIR) [4,5] and the Manchester Patient Safety Framework [6].

For quantitative surveys a number of questionnaires exist, including the "Hospital Survey on Patient Safety Culture" (HSOPS)[7], the "Veterans' Administration Patient Safety Culture Questionnaire" (VHA PSCQ) [8], the "Culture of Safety Survey" (CSS) [9] and the "Safety Attitudes Questionnaire" (SAQ)[10,11]. Reviews of a number of the most widely used quantitative safety culture survey instruments are presented by Colla, Bracken, Kinney and Weeks [12], and by Flin, Burns, Mearns, Yule and Robertson [13].

The purpose of this article is to present the psychometric properties of the generic version of the SAQ on Norwegian data. The version tested was the "Short Form 2006", containing 41 items and having separate response options for perceptions of management: "hospital management" and "unit management".

Methods

Data collection

Setting

The survey was carried out in the somatic clinical areas of Akershus University Hospital October-December 2006. The hospital has 500 somatic (and 200 psychiatric) beds, 4200 employees, and an annual budget of 2.500.000.000 NOK (approximately 450 million US$). It serves a population of 280 000 people, treats 53.000 in-patients and provides 150.000 out-patient consultations annually. Most in-patients (85%) are unscheduled emergency admissions. The safety culture survey was part of a patient safety strategy which the hospital has adopted, which follows guidelines developed by the Institute of Healthcare Improvement [14]. The heads of the clinical departments were informed about the survey in a meeting and in a letter from the CEO.

The study was approved by the Norwegian data inspectorate. We also applied for approval from the Regional ethics committee for medical research in Eastern Norway and they responded that our application was unnecessary because our study did not involve patients.

Questionnaire administration

Data were collected during regular staff meetings in the somatic care-giving units in agreement with the unit leaders, nurses by wards, physicians, physiotherapists and radiographers by department or section. Completing the questionnaire was voluntary. To alleviate fears of small-group responder identification, we promised that results would not be analysed across professions at unit level. Staff not present at the meetings was sent the questionnaire by hospital mail, with a preaddressed envelope and a sheet with information about the survey attached. To keep track of the number of questionnaires administered, questionnaires were numbered individually. The responders names were not recorded in the questionnaire and there were no name-and-number lists. Those who completed their questionnaire during the meeting were crossed out from the list of employees by the unit leader, who later told us who had not attended the meeting and should get their questionnaire by mail. Those who received it by mail crossed out their names on their local unit's list when they had returned the questionnaire. To reduce the number of non-responders, a designated person in the care-giving unit was asked to remind persons who hadn't crossed out their name in meetings and by poster.

Physicians and physiotherapists, who commonly work at more than one care-giving unit, were given the opportunity to fill out one questionnaire for each of up to three units. To keep account of the response rate the three questionnaires filled out by physicians and physiotherapists had the same number, but were supplied with an additional a, b, and c. Physicians and physiotherapists were asked to identify their care-giving unit and department, for other responders these boxes were filled out in advance. The information sheet contained a list of care-giving units participating in the study.

Questionnaires were distributed to 1911 frontline personnel in 47 somatic care giving units of 14 ambulatory clinics, 27 wards, four labs, one operation unit, and one anaesthetic department. 762 staff were given the SAQ in staff meetings and 1149 received it through the hospital's postal system.

The Safety Attitudes Questionnaire

Development and History

The Safety Attitudes Questionnaire is a further development of the Intensive Care Unit Management Attitudes Questionnaire [15,16], originally derived from the FMAQ [17], a traditional human factors survey with a 20-year history in aviation [10]. The SAQ consists of items both from the FMAQ and new items generated on the basis of Vincent's framework for analysing risk and safety [18] and Donabedian's conceptual model for assessing quality [19].

The items were evaluated through pilot testing and exploratory factor analysis which led to identification of the following six factors; safety climate, teamwork climate, stress recognition, perceptions of management, working conditions and job satisfaction.

Items and Factors

The SAQ has been adapted for use in ICUs, operating rooms, inpatient wards, ambulatory clinics, emergency departments, maternity wards, and pharmacies. it also exists in a generic version where the care-giving areas are not specified in the items like in 'Nurse input is well received in this a ICU' but instead kept neutral like in 'Nurse input is well received in this care-giving area'. A short form version is also made where six additional items are included together with 30 items belonging to the six factors. The additional items were added because they were considered interesting in their own right to senior leaders participating in the pilot studies [10]. The items belonging to each factor are listed in Additional file 1. For our study we translated a short form generic version.

Scales and Scoring

The score of the factor scales may be calculated by doing the following. First the results of negatively worded items (2 and 11) must be reversed. One is subtracted from the mean of the set of items from the scale, and the result is multiplied by 25. The percentage of respondents who "agree slightly" or "agree strongly" for each of the items within a factor are charted as the percent positive for each SAQ factor.

Evidence on SAQ data validity and reliability

The SAQ is probably the best documented instrument for measuring patient safety culture [10,12]. Benchmark scores from 203 clinical areas in USA, UK and New Zealand have been published with an overall response rate of 67%, ranging from 66% to 72% across administrations [10]. Incomplete data at item level was approximately 1.5% overall, with a range between 0.3–3.5%. Multilevel confirmatory factor analysis gave a $\chi^2(784) = 10311.27$, $p < 0.0001$; CFI = 0.90 and RMSEA = 0.03. Composite scale reliability was assessed via Raykov's ρ coefficient and was 0.90, which indicates strong reliability.

The SAQ is also the only questionnaire which shows links to patient outcome: a well-developed patient safety culture, as measured by the SAQ, has been shown to correlate with fewer medication errors, lower ventilator associated pneumonia rates, fewer blood-stream infections, and shorter ICU lengths of stay [1,12].

The SAQ is the most widely used instrument for measuring patient safety culture. Including our Norwegian translation the SAQ has now been translated into seven languages, and has been administered in over 1300 hospitals in the USA, United Kingdom, Switzerland, Germany, Norway, Sweden, Spain, Portugal, Italy, Turkey, and New Zealand (written communication, C. Fullwood, Oct 2007).

The translation into Norwegian

Linguistic validation of our translation was performed with the back-translation technique [20]. The questionnaire was first translated from English into Norwegian by one translator and then translated back into the source language by an independent translator (an American nurse and researcher who has worked for many years in Norway and is fluid in both languages), who was blinded to the original questionnaire. We (ED and DH) compared independently the instrument in its original English version and the version translated back to English, and discussed the retranslation with one of the authors of the American questionnaire, resulting in minor reformulations of the translation of a small number of items before the Norwegian version of the questionnaire was tried out at the Akershus University Hospital.

Statistical analysis

Data quality

Missing at item level are shown in Additional file 1 and was on average 2.9%, within a range of 0 to 13%.

The table also shows means and standard deviations for each item. Item responses were clearly skewed towards the positive, but showed considerable variation For all items, all categories were ticked [Additional file 1].

There was also considerable variation across professions, departments, and – particularly – wards, as exemplified by Figures 1, 2 and 3.

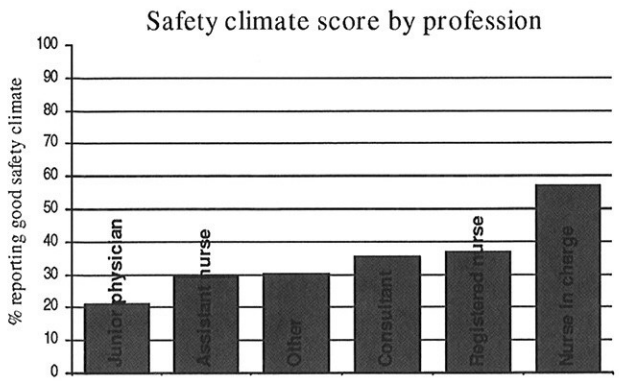


Figure 1
Variation in Safety climate factor average across professions.

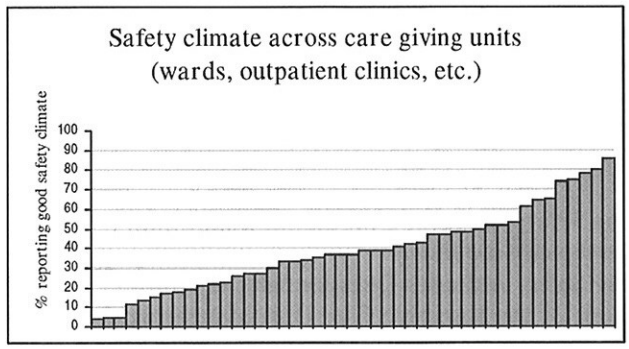


Figure 3
Variation in Safety climate factor average across wards/outpatient clinics.

Data processing

Questionnaires were scanned by the optical reading program Snap Survey. In cases where different postal responders had used different names for the same care-giving unit (for example "S5" and "Big children ward"), we harmonized the names into a complete and mutually excluding list of unit names. The confirmatory analysis was done by AMOS. SPSS was used to estimate Cronbach alphas, item-to-own correlations, intercorrelations of factors, test-retest correlations and all item-descriptive statistics.

Confirmatory factor analysis: internal construct validity

The factor structure of the responses were analysed using AMOS, a program that performs confirmatory analysis

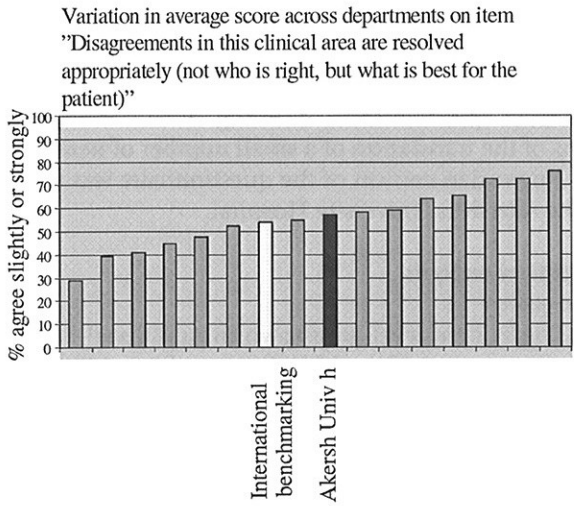


Figure 2
Variation across departments in average score on item "Disagreements in this clinical area are resolved appropriately (not *who* is right, but *what* is best for the patient").

(CFA). CFA is the form of factor analysis which provides formal tests of the goodness of the fit of the pre-hypothesised factor model to the data. We report these goodness-of-fit indices: the chi square, the chi-square/df-ratio, the p, the p_{close}, the Adjusted goodness-of-fit index (AGFI), the Root mean square error of approximation (RMSEA) and the Hoelter 0.05. Acceptable goodness of fit-values indicate internal construct validity of the model – in this case, that what the questionnaire measures is patient safety culture expressed in the hypothesised factors. Suggested criteria values are chi-square not exceeding the number of degrees of freedom of the model, although Wheaton & al [21] suggests accepting any chisquare/df-ratio under 5, and Carmines and MacIver [22] consider values of 2–3 acceptable, whereas Byrne [23] will not accept ratios above 2. The p and p close values should exceed .05 [24], although Jöreskog [25] cautions that large samples may preclude such low p-values even in good models – which is why the Hoelter 0.05 [26] (an estimate of the largest sample for which a data set with these intercorrelations among the variables would confirm the model) should exceed 200. The Adjusted Goodness of Fit Index should be close to 1 – but most AGFIs are, and it is not clear which lower values speak against the model. The Root Mean Square of Approximation (RSMEA) should not exceed 0.10 [24].

Internal consistency

The internal consistency of the factors was assessed by item-total correlations, checking that all items were more highly correlated with the factor they were hypothesised to belong to than with any other factor, and by Cronbach alphas (consistent factors should have alphas exceeding 0.7 [27].

The test-retest reliability was assessed in the hospital's radiology lab, which with its 97 employees is one of the largest clinical units in the hospital. Its questionnaires were, in

addition to the serial number, marked to show if the questionnaire was from the first measurement or the second. The time interval between the two measurements was three weeks. Test-retest stability was assessed by the intraclass correlation coefficient, which should exceed 0.7 [28].

Hypothesised factor structure

Technical reports from the SAQ developers at the University of Texas at Austin and the Johns Hopkins University specifies the six factors as described in Additional file 1 and Table 1[11]. No report on the factor structure of the generic short version of the SAQ has been published. As this version of the questionnaire introduced a split of the questions on perceptions of management into two sets, one on hospital (top) management and one on local (unit) management, we were obliged to reformulate slightly the questionnaire's hypothesised factor structure by imagining two management perception factors instead of one, each containing one set of the five split questions on perceptions of management, as shown in Additional file 2. Because the SAQ Short Form item #29 ("The levels of staffing in this clinical area are sufficient to handle the number of patients") were not included in the items split on unit and top management, we concluded it was not considered a part of the two perceptions of management factors. We hypothesised it to be part of the working conditions factor. In our hypothesised seven factor structure, factors Teamwork climate, Safety climate, Stress recognition, and Job satisfaction are identical with the ones defined by the developers of the non-generic SAQ-versions (except that "this clinical area" was substituted for "this ICU"). The three other factors were hypothesised as in Table 2.

SAQ external validity

Our data set did not include data on patient (un-)safety that could be related to our SAQ-scores. We were, however, given access to two other data sets, collected at the same time and at the same hospital (if only at a few clinical departments), which described patients' evaluations of

Table 1: The six SAQ factors of the non-generic SAQ versions (ICU version)

Teamwork climate	Nurse input is well received in this ICU
	In this ICU, it is difficult to speak up if I perceive a problem with patient care
	Disagreements in this ICU are resolved appriopriately (i.e. not *who* is right, but *what* is best for the patient)
	I have the support I need from other personnel to care for patients
	It is easy for personnel in this ICU to ask questions when there is something that they do not understand
	The physicians and nurses here work together as a well-coordinated team
Safety climate	I would feel safe being treated here as a patient
	Medical errors are handled appropriately in this ICU
	I know the proper channels to direct questions regarding patient safety in this ICU
	I receive appropriate feedback about my performance
	In this ICU, it is difficult to discuss errors
	I am encouraged by my colleagues to report any patient safety concerns I may have
	The culture in this ICU makes it easy to learn from the errors of others
Stress recognition	When my workload becomes excessive, my performanced is impaired
	I am less effective at work when fatigued
	I am more likely to make errors in tense or hostile situations
	Fatigue impairs my performance during emergency situations (e.g. emergency resuscitation, seizure)
Working conditions	This hospital constructively deals with problem physicians and employees
	This hospital does a good job of training new personnel
	All the necessary information for diagnostic and therapeutic decisions is routinely available to me
	Trainees in my discipline are adequately supervised
Job satisfaction	I like my job
	Working in this hospital is like being part of a large family
	This hospital is a good place to work
	I am proud to work ast this hospital
	Morale in this ICU area is high
Perceptions of management	Hospital management supports my daily efforts
	Hospital management does not knowingly compromise the safety of patients
	I am provided with adequate, timely information about events in the hospital that might affect my work
	The levels of staffing in this clinical area are sufficient to handle the number of patients

Table 2: Re-hypotesizing three SAQ factors for the generic SAQ version

Perceptions of hospital (top) management	Hospital management supports my daily efforts Hospital management doesn't knowingly compromise patient safety Hospital management is doing a good job Problem personnel are dealt with constructively by our hospital management I get adequate, timely information about events that might affect my work from hospital management
Perceptions of unit management	Unit management supports my daily efforts Unit management doesn't knowingly compromise patient safety Unit management is doing a good job Problem personnel are dealt with constructively by our unit management I get adequate, timely information about events that might affect my work from unit management
Working conditions	This hospital does a good job of training new personnel All the necessary information for diagnostic and therapeutic decisions is routinely available to me Trainees in my discipline are adequately supervised The levels of staffing in this clinical area are sufficient to handle the number of patients

the organization of the hospital work, patients' suspicion of having possibly been maltreated, and patient record documentation of adverse events [29]. We have therefore been able to correlate our SAQ-scores with the average department patient satisfaction scores (in 4 departments) and with the departments' percentage of patient records containing indications of adverse events (in 6 departments). The low number of departments will not allow any positive conclusions, but a lack of correlation with their SAQ-scores could be considered a sign of low external validity.

Results

Response rates

1306 of the 1911 persons invited to participate completed and returned the questionnaire (68%). Including the additional questionnaires returned by physiotherapists and physicians who served more than one ward, a total of 1460 completed questionnaires were returned. The response rate was much higher for questionnaires distributed in meetings (96%) than for those distributed through the mailing system (50%). The response rate was markedly lower for physicians (52%) than for non-physicians. The response rate varied across units from 44% to 100%.

Item-to-total correlations

All items correlated more highly with its own factor than with any other factor as shown in Additional file 1.

Cronbach's alphas

The Cronbach's alphas (0.68 to 0.85) of our seven factors are shown in Additional file 1. For no factor the exclusion of any variable would noticeably increase the α-value.

Test-retest reliability

Test-retest intraclass correlation coefficients were considerably higher for (additive) factor scores (reversed items were re-reversed before summing) than for single items as shown in Additional file 1, for five of the seven factors test-retest intraclass correlation coefficients exceeded 0.7 (the exceptions were Stress recognition and Perceptions of hospital top management).

Correlations were considerably higher among physicians than among other staff, both for single items and for (additive) factors – for physicians, all intraclass correlations, except for factor Stress Recognition (0.67) were above 0.7.

Construct validity: goodness of fit values for the confirmatory factor analysis model

We tested the factor structure by confirmatory factor analysis. Our factor structure model is presented in Figure 4.

Goodness-of-fit indices for the model are shown in Table 3.

Early external validation

Two indications provide early external validation of the translation used at the Akershus University Hospital. In January-May 2007 the Akershus University Hospital's Quality Department checked the records of a random sample of 481 patient journals in four of the hospital's departments by the Global Trigger Tool Method advocated by the Institute of Healthcare Improvement [30]. The departments' percentage of patients whose records document that they experienced an adverse event during hospitalization correlated strongly (except for the factor Stress recognition) with the departments' average staff SAQ-factor scores, as shown in Table 4 – of course, due to the very low number of departments studied, only one of the correlation coefficients was significant at the 0.05-level.

Also, as shown in Additional file 3, the average SAQ-scores of staff of six departments at the Akershus Univer-

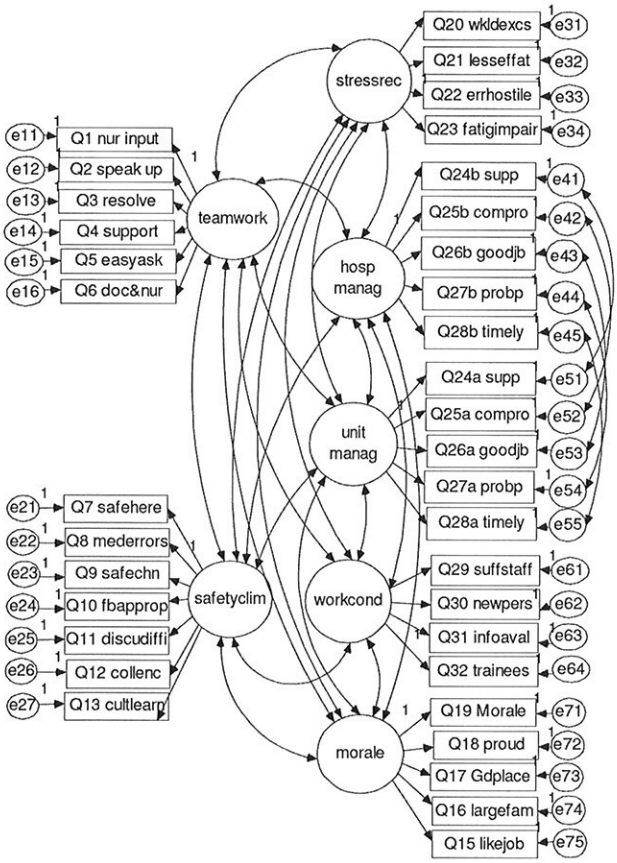


Figure 4
Factor structure model.

sity Hospital correlated with the average scores of 178 randomly chosen patients on questions on possible maltreatment, perceived clumsiness of hospital work and general satisfaction with hospitalization, collected (by the Norwegian Knowledge Centre for the Health Services, which has provided the department average patient scores used to produce additional file 3) at the same period of time at the same departments.

Discussion

Because we personally visited all hospital units to collect the data, we could observe that the questionnaire was met with interest – but generally with less enthusiasm from physicians than from others. The questionnaire was not regarded as threatening. Only two units of the 49 approached declined the invitation to participate, and only one of them because it did not want to go on record at this moment, the other was a laboratory unit which found the generic patient safety questionnaire irrelevant to their tasks. The response rate was relatively high (68% – among physicians, however, only 52%), and, as shown in Additional file 1, very few items produced a large number of missing responses. The outstanding exception was "I experience good collaboration with pharmacists in this clinical area", which had a missing rate of 20%. In our hospital, pharmacists do not participate in daily procedures in care-giving areas; their cooperation with the units is limited to more or less annual inspections. The reason why many have not responded to this item is probably that they found it irrelevant.

A number of respondents asked how to understand the item "Fatigue impairs my performance during emergency situations (e.g. emergency resuscitation, seizure)". Their comments have convinced us that the translation into Norwegian of this item should be reformulated and should not read "Slitenhet reduserer måten jeg opptrer på i krisesituasjoner (som resuscitering, anfall o.l.)" but "Jeg arbeider dårligere i krisesituasjoner (som resuscitering, anfall o.l.) når jeg er sliten".

The questionnaire was not very time-consuming. In all clinical units at the Akershus University Hospital we observed that most responders completed the questionnaire within the 10–15 minutes suggested by the SAQ

Table 3: Goodness-of-fit indices for factor structure model

	Entire model, viewed as a whole (n = 696)	Team-work climate (n = 1082)	Safety climate (n = 0999)	Stress recognition (n = 1039)	Perception of hospital management (n = 922)	Perception of unit management (n = 963)	Working conditions (n = 952)	Morale (n = 1051)
χ^2/d.f.	2.583	6.896	15.923	59.014	2.591	6.373	2.263	6.49
p	< .001	< .001	< .001	< .001	.024	< .001	.104	< .001
P_{close}	.893	.012	< .001	< .001	.646	.042	.616	.051
AGFI	.871	.955	.869	.718	.983	.963	.988	.964
RMSEA	.048	.073	.122	.236	.042	.075	.036	.072
Hoelter .05	296	301	107	53	788	335	1259	359

Table 4: Correlation of average department staff SAQ-scores with department fraction of patient records suggesting an adverse event took place during hospitalization (N = 4)

Average department staff score on teamwork climate:	-0.99 ($p < .01$)
Average department staff score on safety climate:	-0.93 (n.s.)
Average department staff score on stress recognition:	-0.08 (n.s.)
Average department staff score on perceptions of hospital management:	-0.77 (n.s.)
Average department staff score on perceptions of unit management:	-0.93 (n.s.)
Average department staff score on working conditions:	-0.92 (n.s.)
Average department staff score on job satisfaction:	-0.91 (n.s.)

technical reports[11], and all respondents finished within 20–25 minutes.

A data collection challenge was to ensure that all those who participated in patient care at the care-giving units were invited to participate in the data collection. The problem was that many physicians and physiotherapists were not employed by any specific unit and therefore did not attend unit staff meetings. These caregivers had to be reached in their own professions' group meetings.

The relatively high response rate, low number of missing data and the relatively short completion time testify to the acceptability of the SAQ in the Norwegian setting. One item, however, stood out as a candidate for removal, since not many Norwegian clinical workers cooperate directly with pharmacists – in fact, one may wonder why not many more than 20% of the responders left the question of the quality of their cooperation with pharmacists unanswered.

Responses were, for most – but not all – items skewed towards the positive end of the scale. But the response distributions did not suggest that any particular item or set of items should be removed for failing to reflect variation.

All items were, as they should be, more strongly correlated with their own factor than with any of the others.

The relatively high Cronbach alphas for all hypothesised factors demonstrates the internal consistency of the factors: all alphas were between 0.71 and 0.85 – except for the factor Teamwork climate, but its alpha of 0.68 was not much below the recommended limit of 0.70.

The stability of the questionnaire also proved acceptable: the test-retest intraclass correlation coefficients of the factors were relatively high – except for factors Stress recognition (0.55) and Perceptions of hospital management (0.44). A possible interpretation is that in the average clinical worker's eyes, the hospital's top management is so distant that it is difficult to maintain a stable perception of its qualities. The fact that the test-retest correlation for Perceptions of hospital management was practically zero for non-physicians, but quite high (0.83) for physicians lends credibility to that interpretation. The relatively low retest stability of the Stress recognition score, too, was due to the low correlation for non-physicians, whose stress load may feel much more variable and beyond control than the physicians'. The striking difference in the three-week test-retest intraclass correlation coefficients between physicians and others may indeed be seen as suggesting that checking a questionnaire's reliability by the stability of the responses to it is more appropriate among staff who are likely to feel reasonably in command of their work. The items made no reference to the length of the period to be taken into consideration when ticking the questionnaire, and for those more easily subject to the variable demands of those higher in the hospital hierarchy, work must be expected to be appear more variable. Users of the Norwegian translation might want to double-check the test-retest reliability of this factor, and interpret this factor score with due regard to its stability.

The construct validity of the questionnaire, as judged by the goodness-of-fit indicators from the confirmatory factor analysis, can be considered acceptable, but less than perfect. Some of the goodness-of-fit indices speak against the fit of the model to the data, namely the p-value of less than 0.001 and the AGFI of 0.871. But the χ^2-value (2.583) was within the limits indicated by Wheaton et al [21]and Carmines and MacIver[22]. And the p_{close} (0.893) and the RMSEA (0.048) both exceeded the criteria suggested by Browne and Cudeck [24], and the Hoelter 0.05-value of 296 was above the critical value given by Hoelter[26].

The questionnaire cannot be regarded as externally validated until more hospitals have been surveyed and the results from similar units can be compared and related to patient outcomes. However, our informal impression from our feeding the results back to the clinical units and from our presentation of the results to the hospital's top management and to its Quality department is that the responding units seemed to feel not surprised by their SAQ-scores, and that the hospital top management and Quality department felt the scores were credible. Department average scores also correlated with the frequency of

adverse hospital events (as determined by Global trigger tool revision of patient records) and with department average patient reports on general satisfaction with hospitalization, worries about possible maltreatment, and evaluation of the smoothness of hospital work.

Conclusion

On the basis of the above evidence, we conclude that the Norwegian translation of the generic short-form version of the Safety Attitudes Questionnaire is a reasonably reliable and possibly also valid instrument for the measurement of patient safety culture in hospitals.

From our test experience we would, however, like to suggest two minor adjustments. First, comments from the respondents at Akershus University Hospital showed that our translation into Norwegian of the item "Fatigue impairs my performance during emergency situations (e.g. emergency resuscitation, seizure)" should be reformulated as shown above, and listed in Additional file 2. Second, the question on cooperation with pharmacists might be considered for removal from the Norwegian version: very few Norwegian clinical workers cooperate directly with pharmacists.

Finally, one should be aware that the generality of the generic SAQ version is threatened by the word "nurse", which may alienate radiographers, laboratory technicians, secretaries, physiotherapists etc.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

Both authors contributed to the translation of the SAQ into Norwegian, data collection and analysis and the writing of the report. Both authors have read and approved the final manuscript.

Additional material

Additional file 1

Item variation, internal consistency and test-retest reliability (ICC) by factor).

Click here for file

[http://www.biomedcentral.com/content/supplementary/1472-6963-8-191-S1.xls]

Additional file 2

SAQ 2006 Short form, original formulations, Norwegian translations.

Click here for file

[http://www.biomedcentral.com/content/supplementary/1472-6963-8-191-S2.xls]

Additional file 3

Correlation of average department staff SAQ-scores to average department patient scores on (response scale 1–5) variables "General satisfaction with hospitalization", "Maltreatment suspicion", and "Hospital work organization" (N = 6).* **"General satisfaction with hospitalization" = "All things considered, were you generally satisfied with hospital treatment and care?" "Maltreatment suspicion" = "Do you feel that you were in any way maltreated (as far as you are able to judge)?" "Hospital work organization" = An index built from the answers to three questions: "Was it your impression that you were cared for by a permanent group of nursing staff?", "Was it your impression that one doctor were responsible for you?", and "Was it your impression that hospital work was well organized?".*

Click here for file

[http://www.biomedcentral.com/content/supplementary/1472-6963-8-191-S3.xls]

Acknowledgements

We gratefully acknowledge the contributions of Dr. Helge Svaar, Akershus University Hospital, who provided the department Trigger Tool-average scores, of researcher Øyvind Bjertnes, the Norwegian Knowledge Center for the Health Services, who provided the department patient satisfaction averages which we correlated our safety culture scores with and Reidun Skårerhøgda who helped us making tables and figures.

References

1. Pronovost PJ, Berenholtz SM, Goeschel CA, Needham DM, Sexton JB, Thompson DA, *et al.*: **Creating High Reliability in Health Care Organizations.** *Health Serv Res* 2006, **41**:1599-1617.
2. Pronovost PM, Weast BM, Rosenstein BM, Sexton JBP, Holzmueller CGB, Paine LM, *et al.*: **Implementing and Validating a Comprehensive Unit-Based Safety Program.** *Journal of Patient Safety* 2005, **1**:33-40.
3. **"Strategies for leadership: An Organizational Approach to Patient Safety"** [http://www.ihatoday.org/issues/safety/tools/vhatoolfinal.pdf]
4. **"Checklist for Assessing Institutional Resilience" (CAIR)** [http://www.ihi.org/IHI/Topics/PatientSafety/SafetyGeneral/Tools/ChecklistForAssessingInstitutionalResilience.htm]
5. Carthey J, de Leval MR, Reason JT: **Institutional resilience in healthcare systems.** *Qual Saf Health Care* 2001, **10**:29-32.
6. **Manchester Patient Safety Framework (MaPSaF)** [http://www.npsa.nhs.uk/patientsafety/improvingpatientsafety/humanfactors/mapsaf/]
7. Sorra JSNV: **Hospital Survey on Patient Safety Culture.** In *Rockville, MD, Agency for Healthcare Research and Quality* AHRQ Publication 41[04]; 2004. Ref Type: Report
8. Burr M, Sorra J, Nieva VF: ***Analysis of the Veterans Administration (VA) National Center for Patient Safety (NCPS) FY 2000 Patient Safety Questionnaire.* Technical report. Westat: Rockville, MD; 2002.** AHRQ Publication; 2002. AHRQ. Ref Type: Report
9. Weingart SN, Farbstein K, Davis RB, Phillips RS: **Using a multihospital survey to examine the safety culture.** *Joint Commission Journal on Quality and Safety* 2004, **30**:125-132.
10. Sexton J, Helmreich R, Neilands T, Rowan K, Vella K, Boyden J, *et al.*: **The Safety Attitudes Questionnaire: psychometric properties, benchmarking data, and emerging research.** *BMC Health Serv Res* 2006, **6**:44.
11. Sexton JB, Thomas EJ, Helmreich RL, Neilands TB, Rowan K, Vella K, *et al.*: **Frontline Assessments of Healthcare Culture: Safety Attitudes Questionnaire Norms and Psychometric properties. Technical report 04-01.** 2004:1 [http://www.utpatientsafety.org]. 12-12-2007. Ref Type: Report
12. Colla JB, Bracken AC, Kinney LM, Weeks WB: **Measuring patient safety climate: a review of surveys.** *Qual Saf Health Care* 2005, **14**:364-366.

13. Flin R, Burns C, Mearns K, Yule S, Robertson EM: **Measuring safety climate in health care.** *Qual Saf Health Care* 2006, **15:**109-115.
14. Botwinick L, Bisognano M, Haraden C: **Leadership Guide to Patient Safety.** Cambridge, Massachusetts: Institute for Healthcare Improvement. IHI Innovation Series white paper; 2006. Ref Type: Report
15. Sexton JB, Thomas EJ, Helmreich RL: **Error, stress, and teamwork in medicine and aviation: cross sectional surveys.** *BMJ* 2000, **320:**745-749.
16. Thomas EJ, Sexton JB, Helmreich RL: **Discrepant attitudes about teamwork among critical care nurses and physicians.** *Crit Care Med* 2003, **31:**956-959.
17. Helmreich RL, Merritt AC, Sherman PJ, Gregorich SE, Wiener EL: **The Flight Management Attitudes Questionnaire (FMAQ) NASA/UT/FAA Technical Report.** Austin, TX, The University of Texas; 1993:93-4. Ref Type: Report
18. Vincent C, Taylor-Adams S, Stanhope N: **Framework for analysing risk and safety in clinical medicine.** *BMJ* 1998, **316:**1154-1157.
19. Donabedian A: **The quality of care. How can it be assessed?** *JAMA* 1988, **260:**1743-1748.
20. Sperber AD: **Translation and validation of study instruments for cross-cultural research.** *Gastroenterology* 2004, **126:**S124-S128.
21. Wheaton B, Muthén B, Alwin DF, Summers GF: **Assessing reliability and stability in panel models.** In *Sociological Methodology* Edited by: In Heise DRT. San Francisco: Jossey-Bass; 1977.
22. Carmines EG, McIver JP: **Analyzing models with unobserved variables.** In *Social measurement: current issues* Edited by: Borhnstedt GW, Borgatta EF. Beverly Hills: Sage; 1981.
23. Byrne BM: *A primer of LISREL. Basic applications and programming for confirmatory factor analysis models* New York: Springer-Verlag; 1989.
24. Browne M, Cudeck R: **Alternative ways of assessing model fit.** In *Testing structural equation models* Edited by: Bollen KA, Long JS. Newbury Park, California: Sage; 1993:136-162.
25. Jöreskog K: **A general approach to confirmatory maximum likelihood factor analysis.** *Psykometrika* 1969, **34:**183-202.
26. Hoelter JW: **The analysis of covariance structures: goodness-of-fit indices.** *Sociological Methods and Research* 1983, **11:**325-344.
27. Nunnally J, Bernstein I: *Psychometric Theory* 3rd edition. New York: McGraw Hill; 1994.
28. Garratt AM, Bjertnaes OA, Barlinn J: **Parent experiences of paediatric care (PEPC) questionnaire: reliability and validity following a national survey.** *Acta Paediatrica* 2007, **96:**246-252.
29. Oltedal S, Garret A, Helgland J: **Pasienters erfaringer med døgnenheter ved somatiske sykehus – Resultater fra en nasjonal undersøkelse i 2006. 1. 2007.** *Nasjonalt kunnskapssenter for helsetjenesten* . Ref Type: Report
30. Griffin FA, Resar R: **IHI Global Trigger Tool for Measuring Adverse Events.** In *IHI Innovation Series* Cambridge, Massachusetts, Institute for Healthcare Improvement; 2007. Ref Type: Pamphlet

Pre-publication history

The pre-publication history for this paper can be accessed here:

http://www.biomedcentral.com/1472-6963/8/191/prepub

Table 1. Item variation, internal consistency and test-retest reliability

Factor and item	% missing/ does not apply	Mean (sd)	% agree (% agree strongly)	% disagree (% disagree strongly)	* Item - total corre-lation
Teamwork climate (Cronbach's alpha=0.68, ICC=0.72 (Physicians=0.86, Staff=0.64))					
Nurse input is well received in this clinical area	0	4.0 (1.0)	75 (39)	10 (2)	0.66
In this clinical area it is difficult to speak up if I perceive a problem with patient care (reversed scores presented = "higher is better")	1	3.7 (1.3)	62 (34)	24 (6)	0.54
Disagreements in this clinical area are resolved appro-priately (not *who* is right, but *what* is best for patient)	0	3.6 (1.1)	60 (25)	20 (3)	0.70
I have the support I need from other personnel to care for patients	0	4.1 (1.0)	80 (43)	9 (1)	0.65
It is easy for personnel here to ask questions when there is something that they do not understand	0	4.5 (0.9)	89 (65)	6 (1)	0.61
The physicians and nurses here work together as a well-coordinated team	0	3.7 (1.1)	67 (27)	19 (4)	0.69
Safety climate (Cronbach's alpha=0.76, ICC=0.75 (Physicians=0.87, Staff=0.68))					

*** All items correlated more highly with this factor then with other factors**

I would feel safe being treated here as a patient	1	4.0 (1.1)	73 (40)	11 (2)	0.69
Medical errors are handled appropriately in this clinical area	3	3.8 (1.0)	61 (27)	12 (2)	0.72
I know the proper channels to direct questions regarding patient safety in this clinical area	2	3.6 (1.1)	58 (26)	18 (4)	0.63
I receive appropriate feedback about my performance	1	3.2 (1.3)	50 (16)	34 (11)	0.69
In this clinical area, it is difficult to discuss errors (reversed scores presented = "higher is better")	1	3.5 (1.2)	57 (21)	25 (5)	0.49
I am encouraged by my colleagues to report any patient safety concerns I may have	1	3.6 (1.1)	56 (25)	20 (5)	0.64
The culture in this clinical area makes it easy to learn from the errors of others	2	3.5 (1.1)	54 (18)	19 (5)	0.70

*** All items correlated more highly with this factor then with other factors**

Stress recognition **(Cronbach's alpha=0.82, ICC=0.54 (Physicians=0.67, Staff=0.47))**

When my workload becomes excessive, my performanced is impaired	2	3.9 (1.2)	73 (37)	18 (5)	0.81
I am less effective at work when fatigued	1	4.2 (1.0)	84 (47)	10 (3)	0.84
I am more likely to make errors in tense/hostile situations	2	4.1 (1.1)	81 (47)	11 (3)	0.80

Fatigue impairs my performance during emergency situations (e.g. emergency resuscitation, seizure)	4	3.9 (1.2)	69 (33)	17 (5)	0.80

* **All items correlated more highly with this factor then with other factors**

Perceptions of hospital management **(Cronbach's alpha=0.82, ICC=0.44 (Physicians=0.78, Staff=0.02))**

Hospital management supports my daily efforts	4	2.9 (1.1)	28 (7)	35 (12)	0.75
Hospital management doesn't knowingly compromise patient safety	7	2.9 (1.1)	27 (10)	33 (12)	0.78
Hospital management is doing a good job	6	3.2 (1.0)	34 (9)	22 (5)	0.84
Problem personnel are dealt with constructively by our hospital management	13	3.3 (1.2)	17 (4)	19 (6)	0.74
I get adequate, timely information about events that might affect my work from hospital management	6	3.1 (1.0)	33 (8)	28 (7)	0.75

* **All items correlated more highly with this factor then with other factors**

Perceptions of unit management **(Cronbach's alpha=0.84, ICC=0.71 (Physicians=0.88, Staff=0.57))**

Unit management supports my daily efforts	2	3.6 (1.2)	59 (24)	21 (5)	0.76
Unit management doesn't knowingly compromise patient safety	4	3.4 (1.2)	49 (26)	26 (7)	0.74
Unit management is doing a good job	4	3.6 (1.0)	62 (28)	19 (4)	0.83

Problem personnel are dealt with constructively by our unit management	9	3.2 (1.1)	37 (12)	24 (7)	0.73
I get adequate, timely information about events that might affect my work from our unit management	4	3.4 (1.2)	54 (20)	26 (6)	0.80

* **All items correlated more highly with this factor then with other factors**

Working conditions **(Cronbach's alpha=0.71, ICC=0.75 (Physicians=0.91, Staff=0.63))**

This hospital does a good job of training new personnel	2	3.3 (1.2)	41 (19)	28 (8)	0.74
All the necessary information for diagnostic and therapeutic decisions is routinely available to me	10	3.6 (1.1)	61 (23)	23 (4)	0.71
Trainees in my discipline are adequately supervised	6	3.4 (1.1)	55 (18)	25 (4)	0.80
The levels of staffing in this clinical area are sufficient to handle the number of patients	2	2.5 (1.4)	30 (11)	61 (28)	0.69

* **All items correlated more highly with this factor then with other factors**

Job satisfaction **(Cronbach's alpha=0.85, ICC=0.71 (Physicians=0.81, Staff=0.69))**

I like my job	1	4.6 (0.8)	91 (73)	4 (1)	0.74
Working here is like being part of a large family	2	3.6 (1.2)	62 (23)	18 (7)	0.81
This is a good place to work	1	4.2 (1.0)	81 (47)	7 (2)	0.87
I am proud to work in this clinical area	1	4.3 (1.0)	81 (50)	6 (2)	0.87

Morale in this clinical area is high	1	4.3 (0.9)	85 (54)	6 (1)	0.70

*** All items correlated more highly with this factor then with other factors**

Table 3. SAQ 2006 SHORT FORM, ORIGINAL FORMULATIONS, NORWEGIAN TRANSLATIONS*

Response categories

Disagree strongly: Svært uenig / Disagree slightly: Litt uenig / Neutral: Nøytral / Agree slightly: Litt enig / Agree strongly: Svært enig / Not applicable: Spørsmålet passer ikke

1. Nurse input is well received in this clinical area: Sykepleierinnspill blir godt mottatt her

2. In this clinical area, it is difficult to speak up if I perceive a problem with patient care: Her er det vanskelig å si fra om jeg oppdager et problem i pasientbehandlingen

3. Disagreements in this clinical area are resolved appropriately (i.e. not *who* is right, but *what* is best for the patient): Her blir uenighet håndtert riktig (dvs ikke ut fra *hvem* som har rett, men ut fra *hva* som er best for pasienten)

4. I have the support I need from other personnel to care for patients: Jeg får den støtte jeg trenger fra andre sykehusansatte for å ta meg av pasientene

5. It is easy for personnel here to ask questions when there is something that they do not understand: Her er det lett for ansatte å spørre når det er noe de ikke forstår

6. The physicians and nurses here work together as a well-coordinated team: Legene og sykepleierne her samarbeider som et velkoordinert team

7. I would feel safe being treated here as a patient: Jeg ville føle meg trygg hvis jeg var pasient her

8. Medical errors are handled appropriately in this clinical area: Her blir medisinske feil håndtert riktig

9. I know the proper channels to direct questions regarding patient safety in this clinical area: Jeg vet hvilke kanaler jeg skal bruke for å stille spørsmål om pasientsikkerhet her

10. I receive appropriate feedback about my performance: Jeg får passende tilbakemelding om arbeidet mitt (korrekt, tilstrekkelig og fra rett person)

11. In this clinical area, it is difficult to discuss errors: Det er vanskelig å diskutere feil her

12. I am encouraged by my colleagues to report any patient safety concerns I may have: Kolleger oppmuntrer meg til å si fra om enhver pasientsikkerhetsbekymring som jeg måtte ha

13. The culture in this clinical area makes it easy to learn from the errors of others: Kulturen her gjør det lett å lære av andres feil

14. My suggestions about safety would be acted upon if I expressed them to management: Mine forslag om sikkerhet ville bli behandlet om jeg la dem fram for ledelsen

15. I like my job: Jeg liker jobben min

16. Working here is like being part of a big family: Å arbeide her er som å være del av en stor familie

17. This is a good place to work: Dette er et godt sted å arbeide

18. I am proud to work in this clinical area: Jeg er stolt av å arbeide her

19. Morale in this clinical area is high: Innsatsviljen er stor her

20. When my work load becomes excessive, my performance is impaired: Når arbeidsbelastningen min blir for stor, arbeider jeg dårligere

21. I am less effective at work when fatigued: Jeg er mindre effektiv når jeg er sliten

22. I am more likely to make errors in tense or hostile situations: Det er mer sannsynlig at jeg gjør feil når situasjonen blir anspent eller fiendtlig

23. Fatigue impairs my performance during emergency situations (e.g. emergency resuscitation, seizure): Jeg arbeider dårligere i krisesituasjoner (som resuscitering, anfall o.l.) når jeg er sliten (NB: As noted above, this question has been reformulated on the basis of feedback from a number of responders)

24a. Management (unit management) supports my daily efforts: Ledelsen her i enheten legger forholdene til rette for mitt daglige arbeid

24b. Management (hospital management) supports my daily efforts: Sykehusledelsen legger forholdene til rette for mitt daglige arbeid

25a. Management (unit management) doesn't knowingly compromise patient safety: Ledelsen her i enheten gjør aldri noe som de vet kan gå ut over pasientsikkerheten

25b. Management (hospital management) doesn't knowingly compromise patient safety: Sykehusledelsen gjør aldri noe som de vet kan gå ut over pasientsikkerheten

26a. Management (unit management) is doing a good job Ledelsen her i enheten gjør en god jobb

26b. Management (hospital management) is doing a good job Sykehusledelsen gjør en god job

27a. Problem personnel are dealt with constructively by our management (unit management): Ledelsen her i enheten behandler problemmedarbeidere konstruktivt

27a. Problem personnel are dealt with constructively by our management (hospital management): Sykehusledelsen behandler problemmedarbeidere konstruktivt

28a. I get adequate, timely info about events that might affect my work, from management (unit management): Ledelsen er i enheten gir meg adekvat informasjon, i rett tid, om hendelser som kan ha betydning for arbeidet mitt

28b. I get adequate, timely info about events that might affect my work, from hospital management: Sykehusledelsen gir meg adekvat informasjon, i rett tid, om hendelser som kan ha betydning for arbeidet mitt

29. The levels of staffing in this clinical area are sufficient to handle the number of patients: Bemanningsnivået her er tilstrekkelig til at vi kan ta oss av det antall pasienter vi har

30. This hospital does a good job of training new personnel: Dette sykehuset gjør en god jobb med å lære opp nyansatte

31. All the necessary information for diagnostic and therapeutic decisions is routinely available to me: All den informasjon som jeg trenger til diagnostiske og terapeutiske beslutninger er rutinemessig tilgjengelig for meg

32. Trainees in my discipline are adequately supervised: De som er under opplæring på mitt fagfelt, får tilstrekkelig supervisjon

33. I experience good collaboration with nurses in this clinical area: Samarbeidet med sykepleierne er godt i denne enheten

34. I experience good collaboration with staff physicians in this clinical area: Samarbeidet med legene er godt i denne enheten

35. I experience good collaboration with pharmacists in this clinical area: Samarbeidet med farmasøytene er godt i denne enheten

36. Communication breakdowns that leads to delays in delivery of care are common: Kommunikasjonssvikt som fører til forsinkelser i pasientbehandlingen er vanlig

Table 7. Correlation of average department staff SAQ-scores to average department patient scores on (response scale 1-5) variables* "General satisfaction with hospitalization", "Maltreatment suspicion", and Hospital work organization" (N=6)

Correlation of Department average staff score on teamwork climate (6-30) with Department average patient score on	
General satisfaction with hospitalization:	.94 ($p < .01$)
Suspicion of having been maltreated:	.77 (n.s.)
Satisfaction with organization of hospital work:	.69 (n.s.)
Correlation of Department average staff score on safety climate (7-35) with Department average patient score on	
General satisfaction with hospitalization:	.91 ($p < .02$)
Suspicion of having been maltreated:	.69 (n.s.)
Satisfaction with organization of hospital work:	.61 (n.s.)
Correlation of Department average staff score on stress recognition (4-20) with Department average patient score on	
General satisfaction with hospitalization:	.16 (n.s.)
Suspicion of having been maltreated:	.32 (n.s.)
Satisfaction with organization of hospital work:	.37 (n.s.)
Correlation of Department average staff score on perception of hospital management (4-20) with Department average patient score on	
General satisfaction with hospitalization:	.93 ($p < .01$)
Suspicion of having been maltreated:	.84 ($p < .04$)
Satisfaction with organization of hospital work:	.86 ($p < .03$)
Correlation of Department average staff score on perception of unit management (4-20) with Department average paatient score on	
General satisfaction with hospitalization:	.82 ($p < .05$)
Suspicion of having been maltreated:	.71 (n.s.)
Satisfaction with organization of hospital work:	.69 (n.s.)
Correlation of Department average staff score on working conditions (4-20) with Department average patient score on	
General satisfaction with hospitalization:	.87 ($p < .03$)
Suspicion of having been maltreated:	.63 (n.s.)

Satisfaction with organization of hospital work: .54 (n.s.)

Correlation of Department average staff score on job satisfaction (5-25) with Department average patient score on

General satisfaction with hospitalization: .94 ($p < .01$)

Suspicion of having been maltreated: .69 (n.s.)

Satisfaction with organization of hospital work: .65 (n.s.)

*"General satisfaction with hospitalization" = "All things considered, were you generally satisfied with hospital treatment and care?"
"Maltreatment suspicion" = "Do you feel that you were in any way maltreated (as far as you are able to judge)?"
"Hospital work organization" = An index built from the answers to three questions: "Was it your impression that you were cared for by a permanent group of nursing staff?", "Was it your impression that one doctor were responsible for you?", and "Was it your impression that hospital work was well organized?"

Paper III

BMC Health Services Research

RESEARCH ARTICLE Open Access

Patient safety culture lives in departments and wards: Multilevel partitioning of variance in patient safety culture

Ellen Deilkås*, Dag Hofoss

Abstract

Background: Aim of study was to document 1) that patient safety culture scores vary considerably by hospital department and ward, and 2) that much of the variation is across the lowest level organizational units: the wards. Setting of study: 500-bed Norwegian university hospital, September-December 2006.

Methods: Data collected from 1400 staff by (the Norwegian version of) the generic version of the Safety Attitudes Questionnaire (SAQ Short Form 2006). Multilevel analysis by MLwiN version 1.10.

Results: Considerable parts of the score variations were at the ward and department levels. More organization level variation was seen at the ward level than at the department level.

Conclusions: Patient safety culture improvement efforts should not be limited to all-hospital interventions or interventions aimed at entire departments, but include involvement at the ward level, selectively aimed at low-scoring wards. Patient safety culture should be studied as closely to the patient as possible. There may be such a thing as "hospital safety culture" and the variance across hospital departments indicates the existence of department safety cultures. However, neglecting the study of patient safety culture at the ward level will mask important local variations. Safety culture research and improvement should not stop at the lowest formal level of the hospital (wards, out-patient clinics, ERs), but proceed to collect and analyze data on the micro-units within them.

Background

Although the risk of harming patients is evident to most caregivers, eliminating or reducing risk has not always been the first priority of health care management. Management often takes the safety of patients for granted, and considers patient safety as the responsibility of caregivers honouring the guideline "primum non nocere".

Compared to other Scandinavian countries, Norway has only recently made patient safety a national health policy issue, following a series of non-governmental calls for action, most notably by professor emeritus Peter F. Hjort's 2004 policy suggestion [1] and 2007 textbook [2]. In 2007 the Directorate of Health established a national unit for patient safety and in 2009 the Ministry of Health launched a national patient safety campaign.

Efforts to improve patient safety may follow several lines of action, including mortality-and-morbidity conferences, sentinel event scrutiny, restructuring of care delivery systems and safety culture surveys [3]. Each strategy has its merits, and surveying safety culture is a useful option, not least because a common experience in patient safety improvement work is that interventions directed against specific causes of adverse events often result in only temporary improvement. One possible interpretation is that adverse events have multiple causes, and the quintessential explanation is the priority of safety reflected in the general patient safety culture of the unit in which the adverse events occur.

The aim of the study was to test the hypothesis that patient safety culture is a local phenomenon, implying that patient safety culture scores vary considerably by hospital department and ward, and that much of the variation is across the lowest level organizational units: the wards.

* Correspondence: ellen.deilkas@kunnskapssenteret.no
Health Services Research Unit, Akershus University Hospital, Norway

Methods

Study design

This study analyzes patient safety attitudes data on clinical staff at Akershus University Hospital. Responses of staff to a patient safety attitudes questionnaire were collected from October to December 2006. If our hypothesis was correct, we would expect to find considerable clustering of the safety attitude scores at the department and ward level, i.e. non-trivial-to-high intraclass correlation coefficients.

The study plans were presented to the Regional Ethical Committee for Medical Research in Eastern Norway for approval. The Committee decided the project did not require their approval as it did not involve collecting data on patients. The collection of data on clinical staff was approved by the proper government authority, the Norwegian Data Inspectorate.

Setting and participants

Akershus University Hospital is located just outside Oslo, the capital of Norway. In 2006 the hospital had 500 somatic and 200 psychiatric beds, 4200 employees, and an annual budget of 2.500.000.000 NOK (approximately 450 million USD). It is a general hospital with a wide variety of specialities, but it does not include an eye clinic and a geriatric department. In 2006 it served a population of 280 000 inhabitants of Northeast Oslo and the Northeastern part of the Oslo-surrounding county of Akershus. It treated 53.000 inpatients and had 150.000 outpatient consultations. Eighty-five percent of the inpatients were unscheduled emergency cases.

The questionnaire was distributed to all clinical staff (physicians, registered nurses, auxiliary nurses, radiographers, laboratory technicians, midwives, and clerical workers) at 45 somatic caregiving units - 27 wards, 14 outpatient service units, and four laboratories - of 10 clinical departments: emergency admissions, anesthesiology, surgery, operations, orthopedics, gynecology and obstetrics, pediatrics, internal medicine, neurology and ear-nose-throat.

The survey

The survey instrument used was (the Norwegian translation of) the Safety Attitudes Questionnaire (the SAQ) Short Form 2006. The original (American) version of the questionnaire is described by Sexton, Helmreich, Neilands et al. [4]. The Norwegian version of the SAQ has 41 questions, of which 36 reflect seven patient safety culture dimensions: Team Climate, Safety Climate, Job Satisfaction, Stress Recognition, Perception of Unit Management, Perception of Hospital Management and Work Conditions. The items which reflect each dimension are listed in Deilkås & Hofoss [5], which also describes the development of the Norwegian version of the SAQ and the assessment of its psychometric properties.

Data collection

The survey was carried out at the hospital's somatic clinical areas during October-December 2006.

The questionnaires, which took approximately 15-20 minutes to complete, were distributed and completed at regular staff meetings. Forms were to be completed anonymously and did not have an ID number which could be used to trace the responder. Employees who did not attend the staff meeting were sent their SAQs through the hospital's internal mail system. As the questionnaires were anonymous, we had no way of reminding non-responders, except for asking the ward and department heads to urge their staff to participate.

Statistical analysis

To calculate the factor scores, we reversed the scores on the negatively worded items (2 and 11). For each factor, the mean of the item scores was calculated. One was subtracted from each mean, and the result was multiplied by 25.

To partition the variation of the dimension scores by organization level, the seven patient safety culture scores were analyzed by MLwiN, a multilevel analysis program developed by the University of London's Institute of Education [6]. The program is now being distributed and expanded by the University of Bristol's Centre for Multilevel Modelling [7]. Multilevel analysis makes it possible to partition the total variance in each dimension score into variance across individual respondents (individual level variance), variance across wards (ward level variance) and variance across departments (department level variance). Analyzing the model which contains only the intercept (the data set's average patient safety attitudes score) and no explanatory variables - what is known as "the empty model" [8] - one can calculate the percentage of the total variance in patient safety attitudes scores that reside at the organizational level, that is, the percentage of the variance which is not score differences across individual responders, but across the organizational units.

The ratio of the variance at the organizational level to the total variance in the data is the intraclass correlation coefficient (ICC). Multiplied by 100, the ICC can be interpreted as the percentage of the total variance in the data set which belongs at the organizational level, that is, the percentage of the variance that is not differences across individual responders, but across the organizational units. By defining the multilevel model as having three levels - employee, ward and department - the

MlwiN output showed how much the individual scores varied around the grand mean of each dimension score, as well as the variance in ward averages and department averages. The null hypothesis was that there was no clustering by organization level in the response data, implying that there were no differences among wards or among departments, i.e. all of the variance was across individual responders, and no ward or department stood out as a more promising candidate for patient safety improvement than any other ward or department. Our alternative hypothesis was that our data would show significant differences across wards and across departments, implying that patient safety improvement work should not address all departments and wards with the same reforms, but focus on the specific problems in units with lower scores. The results are shown in Table 1.

The statistical significance of the variance at organization levels was judged by the change in the goodness-of-fit of the model to the data, as measured by the change in the model's log likelihood ratio produced by eliminating that level from the model. Judging significance by the ratio of the parameter estimate to its standard error works quite well for fixed parameters, that is, parameters estimated under the assumption of having the same value in all subunits of the data set. For random parameters, however, the distribution of this ratio may depart considerable from normality, and a better test for random parameters is to use the likelihood ratio statistic [9]. In our case, the "large sample" distribution of the -2LL-value under the null hypothesis (H_0 = the two-level model is adequate) is a χ^2-distribution with k_2-k_1 degrees of freedom - that is: d.f. = 3-2 = 1. The critical value for p <,05 for the change in -2LL is 3,84; for p <,01, it is 5,99. As suggested by Pinheiro & Bates (10), this test can be conservative, producing from the $\chi^2_{k2\text{-}k1}$ distribution a p-value which is greater than it should be. What we did, then, was to respecify our models, removing from them the idea that there was variation across department to see how much - if at all - the respecification damaged the three-level models' goodness-of-fit. If we were correct in assuming significant score variation at all three levels, the two-level model would prove a worse fit to the data than the three-level model. The results are shown in Table 2.

Results

All clinical staff, a total of 1911, were asked to complete the SAQ, and 1306 (68%) did. The response rate was higher among nurses, auxiliary nurses, midwives, laboratory technicians, radiographers, physiotherapists and other staff with less education (as compared to the physicians). Response rates were higher (98 percent) among those who received their SAQs at staff meetings. Further details on response rates are published in Deilkås & Hofoss [5].

As shown in Table 1 five of the seven patient safety dimension scores showed considerable variance at the organizational level. Except for Stress Recognition (ICC =,02) and Perception of Hospital Management (ICC =,07) all dimensions had ICCs of 14 percent or higher. The highest ICC value was for Perception of Unit Management (21 percent) and Teamwork Climate (19 percent). For the dimension Work Conditions, clustering was more pronounced at the department level than at the ward level. For the dimensions of Teamwork Climate, Safety Climate and Perception of Unit Management, clustering was more pronounced at the ward level.

Table 1 Organization level variance by patient safety attitudes dimension

Dimension (all dimensions scaled 0-100)	Total variance	Variance at individual level (% of total variance)	Variance at ward level (% of total variance)	Variance at department level (% of total variance)	ICC (ratio of organizational level variance to total variance)
Teamwork Climate (valid n: 1090)	285,365	231,298 (81,1%)	39,245 (13,8%)	14,822 (5,2%)	0,19
Safety Climate (valid n: 984)	240,638	206,303 (85,7%)	21,733 (9,0%)	12,602 (5,2%)	0,14
Job Satisfaction (valid n: 1036)	365,350	309,274 (84,7%)	28,081 (7,7%)	27,995 (7,7%)	0,15
Stress Recognition (valid n: 1024)	491,506	483,168 (98,3%)	1,140 (0,2%)	7,198 (1,5%)	0,02
Work Conditions (valid n: 843)	411,830	352,886 (85,7%)	20,704 (5,0%)	38,240 (9,3%)	0,14
Perception of Unit Management (valid n: 949)	519,785	412,491 (79,4%)	68,706 (13,2%)	38,588 (7,4%)	0,21
Perception of Hospital Management (valid n: 904)	373,291	347,452 (93,1%)	12,430 (3,3%)	13,409 (3,6%)	0,07

Table 2 Organization level variance by patient safety attitudes dimension

Dimension	-2LL of three-level Model	-2LL of two-level model (individuals & wards)	Change in -2LL when department level was removed from model
Teamwork Climate	9103,317	9103,477	0,163 (n.s.: p > ,05)
Safety Climate	8095,995	8101,995	5,532 (p < ,05)
Job Satisfaction	8940,755	8946,288	5,533 (p < ,05)
Stress Recognition	9245,302	9248,427	3,125 (n.s.: p > ,05)
Work Conditions	7283,521	7289,960	6,439 (p < ,01)
Perception of Unit Management	8482,990	8484,253	1,263 (n.s.: p > ,05)
Perception of Hospital Management	7887,215	7890,124	2,809 (n.s.: p > ,05)

As shown in Table 2, for four of the seven dimensions - Teamwork Climate, Stress Recognition, Perception of Unit Management and Perception of Hospital Management - the elimination of the department level from the model did not reduce the model's goodness-of-fit significantly, as measured by the change in the -2LL. For the remaining three dimensions - Safety Climate, Job Satisfaction, and Work Conditions - the exclusion of the department level from the model did worsen the model's goodness-of-fit.

Discussion

Given that hospital top management wish to improve patient safety culture, where should they intervene? Obviously, patient safety culture scores depend on the personal interest, attention and engagement of each staff member. The major part of the variance in patient safety attitudes was across individual employees, so efforts to promote a patient safety culture must continue targeting individual staff members. But we also found marked clustering of patient safety culture scores at the organizational levels, and much of the organization level variance was across wards. In some patient safety culture dimensions department averages differ, but in other dimensions, wards vary more strongly than departments. Therefore, interventions to improve patient safety should aim not only at individual employees, but also at organizational units, in particular those at the sharpest end of the health services: the wards.

Having data on one hospital only, we have not been able to check empirically the amount of clustering of safety attitudes at the hospital level, but, as indicated by Sexton, Helmreich, Neilands et al. [4], there probably are hospital-specific patient safety cultures. However, as shown by Pronovost & Sexton [11] and by Singer [12], variability in SAQ measurements may be greater across working groups than across hospitals. This analysis adds to the suggestion that strategies for improving safety climate and patient safety should be tailored for work areas and disciplines by estimating the relative size of the variances at ward and department levels for each of the seven safety attitudes dimensions.

As we have documented significant clustering of three patient safety attitude dimensions at the department level (safety climate, job satisfaction, and work conditions), it should be noted that there may be differences in patient safety culture across departments. However, for four of the seven dimensions, there was no evidence of variation across departments, only across wards.

Patient safety culture improvement efforts should, therefore, include interventions at the ward level, and not just department or all-hospital interventions. Zohar et al. [13] has reported how information on safety climate has been used to guide prevention efforts toward selected units. Selection must, however, be done with discretion in order to avoid stigmatizing working units as "low-score." And one must not focus solely on the low scorers: high-scoring units may also be interesting; lessons may be learnt from their successes.

Possibly, even probably, one should in the future also aim at studying even lower-level units, the "micro-systems" that do not appear in organizational blueprints, but in which so much of the actual clinical work is carried out [14-16]. The importance of studying such lower-level units is obvious enough in medical departments. One may easily see patient safety as a function of the safety culture of sub-groups of nurses or small nurse-doctor groups within a ward. The point is particularly obvious in surgical departments, where the wards are the bed units where patients are prepared for surgery and nursed after having undergone surgery, but the work that gives the department its name - and is vital to surgical patients' safety - takes place in the theatres of the department's operating section. Studying surgical department patient safety at the ward level, although bedside, one might easily miss important information. A data collection problem is that micro-systems like operating teams are temporary groups, which do not have permanently designated staff. This may differ among organizations: at our hospital operation teams are temporary, but in other organizations they may be permanent. The inclusion of the micro-unit level into multi-level analyses of patient safety attitudes and other

aspects of patient safety is an important task for future patient safety research.

Conclusions

1) Patient safety culture should be studied in care-giving units as close to the patient as possible. There may be such a thing as "hospital safety culture," and there are differences across hospital departments. However, neglecting the study of patient safety culture at the ward level will mask important local variations.

2) Patient safety culture improvement efforts should include interventions at ward level, not just department or all-hospital interventions.

3) Future research should not stop at the level of hospital wards, out-patient clinics, and ERs, but collect and analyze data on the micro-systems within them: nurse teams, doctor-nurse teams, operating teams etc.

Acknowledgements
The study was partly funded by grants from the Eastern Norway Regional Health Authority, which in 2006 awarded Ellen Deilkås a three-year PhD scholarship.

Authors' contributions
The two authors jointly designed the study, collected, analyzed and interpreted the data and wrote the manuscript.

Competing interests
The authors declare that they have no competing interests.

Received: 14 July 2009 Accepted: 31 March 2010
Published: 31 March 2010

References

1. Hjort PF: *Uheldige hendelser i helsetjenesten: forslag til nasjonalt program for forebygging og håndtering (Adverse events in health care: suggestion for a national program)* Oslo, Norway, Social and Health Department 2004.
2. Hjort PF: *Uheldige hendelser i helsetjenesten - en lære-, tenke- og faktabok (Adverse events in health care)* Oslo, Gyldendal Norsk Forlag 2007.
3. Hofoss D, Deilkas E: **Roadmap for patient safety research: approaches and roadforks.** *Scand J Public Health* 2008, **36**:812-7.
4. Sexton J, Helmreich R, Neilands T, Rowan K, Vella K, Boyden J, Roberts PR, Thomas EJ: **The Safety Attitudes Questionnaire: psychometric properties, benchmarking data, and emerging research.** *BMC Health Serv Res* 2006, **6**:44.
5. Deilkas E, Hofoss D: **Psychometric properties of the Norwegian version of the Safety Attitudes Questionnaire (SAQ), Generic version (Short Form 2006).** *BMC Health Serv Res* 2008, **8**:191.
6. Rasbash J, Steele F, Browne W, Prosser B: *A user's guide to MLwinN* London, University of London, Institute of Education, Centre for Multilevel Modelling 1996.
7. **Centre for Multilevel Modeling. University of Bristol.** [http://www.cmm.bristol.ac.uk/].
8. Snijders T, Bosker R: *Multilevel analysis. An introduction to basic and advanced multilevel modeling* London, Sage Publications 2002.
9. Woodhouse G: *Multilevel modelling applications. A guide for users of MLn* London, University of London, Institute of Education 1996.
10. Pinheiro J, Bates D: *Mixed-effects models in S and S+* New York: Springer 2004, 83-4.
11. Pronovost P, Sexton B: **Assessing safety culture: guidelines and recommendations.** *Qual Saf Health Care* 2005, **14**:231-3.
12. Singer SJ, Gaba DM, Falwell A, Lin S, Hayes J, Baker L: **Patient safety climate in 92 US hospitals: differences by work area and discipline.** *Medical Care* 2009, **47**:23-31.
13. Zohar D, Livne Y, Orly T, Admi H, Donchin Y: **Healthcare climate: a framework for measuring and improving patient safety.** *Critical Care Medicine* 2007, **35**:1312-7.
14. Mohr JJ, Batalden PB, Barach P: **Integrating patient safety into the clinical microsystem.** *Qual Saf Health Care* 2004, **13(Suppl 2)**:ii34-8.
15. Berwick DM: **A user's manual for the IOM's "Quality Chasm" report.** *Health Aff* 2002, **21**:80-90.
16. Mohr JJ, Batalden PB: **Improving safety on the front lines: the role of clinical microsystems.** *Qual Saf Health Care* 2002, **11**:45-50.

Pre-publication history
The pre-publication history for this paper can be accessed here:
http://www.biomedcentral.com/1472-6963/10/85/prepub

doi:10.1186/1472-6963-10-85
Cite this article as: Deilkås and Hofoss: **Patient safety culture lives in departments and wards: Multilevel partitioning of variance in patient safety culture.** *BMC Health Services Research* 2010 **10**:85.